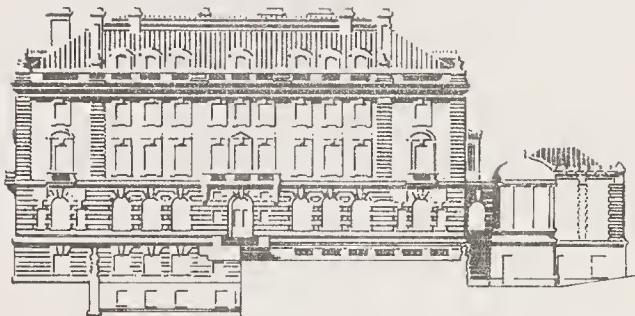




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# NOMENCLATURE OF COLOURS

APPLICABLE TO THE

ARTS AND NATURAL SCIENCES

TO

MANUFACTURES

AND OTHER PURPOSES OF GENERAL

UTILITY

BY  
David R. HAY  
*in*

SECOND EDITION IMPROVED

SMITHSONIAN

NOV 6. 1980

LITERARIES

WILLIAM BLACKWOOD & SONS  
EDINBURGH AND LONDON

MDCCCXLVI

1846

GIFT OF  
COLOR ASSOCIATION  
OF THE UNITED STATES  
1978

EDINBURGH: PRINTED BY BALLANTYNE AND HUGHES,  
PAUL'S WORK, CANONGATE.

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## INTRODUCTION.

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THERE is not amongst the various phenomena of nature, one that more readily excites our admiration, or imparts a more vivid impression of the order, variety, and harmonious beauty of the creation, than that of colour. On the general landscape this phenomenon is displayed in the production of that chromatic beauty in which the elements of colour are so variously and harmoniously blended, and in which they are by light, shade, and distance, modified in such an infinity of gradation and hue. Although genius is continually struggling, with but partial success, to imitate those effects, yet through the Divine beneficence, all whose organs of sight are in an ordinary degree of perfection, can appreciate and enjoy them. In Winter this pleasure is often to a certain extent withdrawn, while the colourless snow alone

clothes the surface of the earth; but this is only a pause in the general harmony, which, as the Spring returns, addresses itself the more pleasingly to our perception in its vernal melody: this, again, gradually resolving itself into the full rich tones of luxuriant beauty exhibited in the foliage and flowers of Summer, which subsequently rise into the more vivid and powerful harmonies of Autumn's colouring, prepares the eye again to enjoy that rest which such exciting causes may be said to have rendered necessary.

When we pass from the general colouring of nature to that of particular objects, we are again rapt in wonder and admiration by the beauty and harmony which so constantly and in such infinite variety present themselves to our view, and which are so often found combined in the most minute objects. But the systematic order and uniformity perceptible amidst this endless variety in the colouring of animate and inanimate nature, is another characteristic of beauty equally prevalent throughout the creation.

By this uniformity in colour various species of animals are often distinguished, and in each individual of most of these species, how much is this beauty enhanced when the uniformity prevails in the resemblance of their lateral halves! The human countenance exemplifies this in a striking manner; the slightest variety of colour between one and another of the double parts is at once destructive of beauty. Many of the lower animals, whether inhabitants of the earth, the air, or

the water, owe much of their beauty to this kind of uniformity in the colour of the furs, feathers, scales, or shells, with which they are clothed.

In the vegetable kingdom we find a great degree of uniformity of colour in the leaves, flowers, and fruit of the same plant, combined with all the harmonious beauty of variety which a little careful examination develops.

In the colours of minerals, too, the same may be observed. In short, in the beauty of colouring, as in every other species of beauty, uniformity and variety are found to combine.

An appreciation of colour depends, in the first place, as much upon the physical powers of the eye in conveying a proper impression to the mind, as that of music on those of the ear. But an ear for music, or an eye for colour, are, in so far as beauty is concerned, erroneous expressions; because they are merely applicable to the impression made upon the senses, and do not refer to the æsthetical principle of appreciation, by which harmony and beauty can alone be understood.

A good eye, combined with experience, may enable us to form a correct idea as to the purity of an individual colour, or of the relative difference existing between two separate hues; but this sort of discrimination does not constitute that kind of appreciation of the harmony of colour, by which we admire and enjoy its development in nature and art. The power of

perceiving and appreciating beauty of any kind, is a principle inherent in the human mind, which, like every other mental power, may be improved by cultivation. Great pains has been bestowed on the education of the ear, in assisting it to appreciate the melody and harmony of sound ; but much still remains to be done in regard to the cultivation of the eye in appreciating form and colour.

It is true that there are individuals whose powers of vision are perfect in so far as regards the appreciation of light, shade, and configuration, but who are totally incapable of perceiving the effect of the intermediate phenomenon of colour, every object appearing to them either white, black, or neutral grey ; others who are equally blind as to the effect of one of the primary elements of colour, and see the other two singly and combined ; while there are many who, having the full physical power of perceiving all the varieties of the phenomenon, and who are even capable of making nice distinctions, are yet incapable of appreciating the æsthetical quality of harmony which exists in a proper combination of the elements of chromatic beauty. It is the same with respect to the effects of sounds upon the ear—some have organs so constituted, that notes above or below a certain pitch are to them inaudible ; while others with physical powers otherwise perfect, are incapable of appreciating either melody or harmony in musical composition.

But perceptions so imperfectly constituted, are, by

the goodness of the Creator, of very rare occurrence ; therefore all attempts at improvement in the science of æsthetics, must be suited to the capacities of the generality of mankind, amongst whom the perception of colour exists in a variety as great as that by which their countenances are distinguished. Some artists have this perception intuitively in such perfection, that they are capable of transferring to their works the most beautiful harmonies and most delicate gradations of colours, in a manner that no acquired knowledge could have enabled them to do. To those who possess such a gift, as well as to those to whom the Deity in his infinite wisdom has denied the ordinary powers of perception, it would be equally useless to offer an explanation of the modes of arrangement, or to attempt a definition of the almost infinitely various colours, hues, tints, and shades arising out of the simple elements of this phenomenon. But to those whose powers lie between these extremes, being neither above nor below cultivation, such an explanation and definition must form a step towards the improvement of that inherent principle which constitutes the basis of æsthetical science.

The variety and harmony of colour which nature is continually presenting to our view, is apparent to all whose visual organs are in a natural state, and thus to the generality of mankind ; but a knowledge of the simplicity of the elements producing this variety and beauty, has been the result of ages of philosophic research and experimental enquiry.

Light is understood to be an active, and darkness a passive principle; while colour is an intermediate phenomenon.

According to Goethe, the eye owes its existence to light, which calls forth, as it were, a sense that is akin to itself; or, in other words, that a dormant light resides in the eye, which may be excited from within or from without. Goethe observes—"In darkness, we can, by an effort of our imagination, call up the brightest images; in dreams, objects appear to us as in broad daylight; awake, the slightest external action of light is perceptible, and, if the organ suffers an actual shock, light and colours spring forth."\*

He likewise clearly shows that colour is a law of nature in relation with the sense of sight, as well as an elementary phenomenon, which, "like all others, exhibits itself by separation and contrast, by com-mixture and union, by augmentation and neutraliza-tion, and by communication and dissolution."† Under these general terms, the nature of colour is fully comprehended.

White and black are representatives of the principles of light and darkness; and yellow, red, and blue, the

\* Goethe's *Theory of Colours*, translated by Eastlake. London: J. Murray. 1840. Introduction, p. 39. A work rendered as valuable to the artist by the notes and observations of the translator, as it is interesting to the general reader by the truly philosophical, and, at the same time, popular manner in which the subject is treated.

† *Ibid.*

primary elements of colour, out of which, by commixture and union amongst themselves, every conceivable variety of colour and hue arises.

The nature and qualities of these elements of chromatic beauty must be well understood before a correct idea can be formed of, or proper names given to, their various combinations. White and black are not colours themselves, but are, as the representatives of light and darkness, simply the modifiers of colours, in reducing them, and the hues arising from them, by their attenuating and neutralizing effects, to tints and shades respectively.

The distinctive characteristic of a mixed colour, must therefore depend upon the mode in which the primaries are combined in its composition ; and, as these elements are but three in number, we can only have other two distinct kinds ; namely, those in which two of them occur called secondary colours, and those in which the whole three are combined, generally called tertiary colours. These last are, however, more properly called hues, because they are colours only by the predominance or subordination in their composition of one or other of the three primaries, above or below its natural power of neutralization, as shall afterwards be shown.

So much for the nature of the primary elements of colour. Their powers shall now be considered.

That these elements can be produced in perfect purity, seems a physical impossibility ; even in the

solar spectrum they cannot be perfectly separated by any refracting power yet discovered, but are all to a certain extent mixed with those that lie next them in series. Notwithstanding this difficulty, their powers have been ascertained by various practical experiments, especially those performed by Field,\* to be, in regard to their capability of reflecting light in ratios, somewhat similar to those of the tonic, mediant, and dominant of the musical scale, or more properly to the harmonic ratios. It will therefore be found, that taking the purest powdered pigments that art can produce, and mixing them in the proportions—one yellow, two red, and three blue, of equal intensity, a cool gray, such as produced by the mixture of white and black, will be the result.

It has long been maintained, that these three colours will produce white light. This, however, cannot be the case; for colours can only be excited, as in the solar spectrum, by the joint influence of light and darkness, and are an intermediate phenomenon between these two principles, the natural concurrence of which, in the absence of a refracting power, is, as in the mixture of pigments, a cool gray.

We know, that although colour cannot be perceived

\* “*Chromatography; or, a Treatise on Colours and Pigments.*” By George Field. London: Charles Tilt. It will be observed that my ratios differ from those of Field; his being 3, 5, 8, and those I have adopted 3, 6, 9, or simply 1, 2, 3. My reason for deviating from so excellent an authority, will appear in the sequel.

without light, that light alone cannot constitute colour, and that a certain proportion of the passive principle of darkness enters into the constitution of each of the primaries; consequently the principles of light and shade must coexist while colour is present; therefore their union cannot possibly produce either black or white, but the intermediate hue, gray.

This seems the true nature of colours in regard to light and shade; but they have a relative power amongst themselves, which in some measure gives them a new character. The ruling principle of colour is warmth, but white and black are essentially cold; and yellow and blue in their purest state being allied to them, must also partake of this quality. Intermediately, however, between these, the most positive and most powerful of individual colours, red, arises; a colour which communicates warmth to every combination into which it enters. It is therefore pre-eminent amongst colours, and may be justly termed the life-blood of every chromatic composition.

The other two primary colours may be termed links between colour and the principles of absolute light and darkness, represented by white and black, while absolute colour is represented by red.

## OF PRIMARY COLOURS.

## RED.

Intense red is the most powerful of colours in regard to its effect upon the eye, and in the colouring of nature it occurs rarely and in small portions. Its effect in art when covering any large space, is gorgeous and powerful; and on all occasions the predominance of red is ostentatious, and congenial to the most primitive ideas of grandeur. It unites with the other two primaries in the production of the secondary colours, orange and purple, which are its melodizing tones, and the union of the other two primaries in green, forms its contrasting colour. The tertiary colour or hue in which red predominates, is a reddish-brown called russet.

From the medial position of red in the chromatic scale, and from its power in subduing the effect of such colours as enter in small proportions into combination with it, there is no colour the name of which is oftener misapplied. The first decided change that occurs in its admixture with yellow, is intense scarlet; and in its progress on the other side towards blue, the first change that takes place upon it, is the production of that beautiful species of red called crimson; but be-

fore arriving at either of those understood colours, it passes through many gradations, to all of which, as well as to many other modifications of this primary, the term red is indiscriminately applied.

Amongst flowers, red is a predominating colour, often in great purity, as in the flower of the verbena, the geranium, and many others. Its various gradations of tint are nowhere more beautifully and delicately displayed than in the ordinary varieties of the rose; and it is often beautifully blended with its contrasting colour green, in the productions of the orchard.

Red sometimes occurs in considerable purity in the natural productions of the mineral kingdom, both in transparent and opaque substances. Of the former, the oriental ruby is the most conspicuous, and of the latter, the mineral called cinnabar, a native sulphurate of mercury. But, perhaps, the nearest approximation to pure red in nature, is the production of the animal kingdom, the cochineal, a small insect from which carmine is made. Many of the feathered tribes, also, exhibit it in much perfection and beauty in the plumage with which nature has adorned them. But it would be an endless task, and apart from the object of this work, to go into minute details regarding the infinite varieties of colour which the botanist, the naturalist, and the mineralogist, find amongst the objects of their study. My purpose is, however, to attempt to classify, arrange, and define colours, in

order to enable those who are following such branches of study, as well as the artist, more easily to comprehend the nature of each particular hue, tint, and shade, and the relation that it bears to the primary elements of light, darkness, and colour. By this knowledge, a description may be given where no proper name can be applied, and every compound become as well understood as the primary elements, yellow, red, and blue.

In art, the purest red that can be produced is carmine, a pigment made from cochineal, of which Figure I. Plate 1, is a specimen. In sunshine and in artificial light, red is more brilliant than in ordinary daylight, and it is most deteriorated when viewed in a northern aspect, when the sky is clear.

### YELLOW.

Yellow is the primary colour that, in the natural scale, occurs between red and the active principle of pure light; and is consequently the brightest in the solar spectrum, and the lightest and most delicate of the primary colours. In the neutral gray, its power is therefore greater than that of the other two, being more allied to light, as already shown.

In artificial light, the purest yellow loses much of its intensity, and can scarcely be distinguished from white. This arises from such lights being generally of a yellow tone, and consequently diffusing this colour

over all objects within their influence. In daylight its effect is that of gaiety approaching to gaudiness, and its predominance is generally offensive to the eye.

Yellow combines with red in the production of orange colour, and with blue in that of green, which colours are its melodizing tones. Its contrasting colour is purple, resulting from the combination of the other two primaries. The hue in which yellow predominates is called citrine, a compound of orange colour and green.

In the vegetable kingdom, yellow is exhibited in great purity, and in much variety of tint in many flowers. Amongst animals, it often occurs in the plumage of birds, and sometimes in the furs of animals and scales of fishes.

The admixture of red alters its tone towards warmth, but does not very apparently change its character until it approaches orange colour; hence many mixtures of this kind are improperly called yellow. But from its alliance to light, and from blue being allied to darkness, the smallest admixture of that colour changes it to a greenish tone, thereby effectually changing its character.

In the mineral kingdom, sulphur is probably the only opaque natural substance that approaches to pure yellow; and some of the topazes give this colour translucently, although generally tinged with brownish red.

The pigments used in art are for the most part the product of minerals, amongst which the chromate of

lead, called chrome yellow, is the purest. Figure 2, Plate I., is this pigment.

### BLUE.

Blue is the third of the primary colours, and belongs more to the principle of darkness or shade than either of the other two, and it is consequently the most retiring of the three. It is also of these elements the most cool and pleasing to the eye, associating, as it does, with the groundwork of the retina itself. It imparts to every hue of which it forms a constituent, a cooling and retiring quality, and enters into combination with yellow in the production of green, and with red in that of purple, which are consequently its melodizing colours. The contrasting colour to blue is orange, and the tertiary in which it predominates is olive—a composition of green and purple. Blue is much deteriorated and neutralized in artificial light, and is therefore decidedly a daylight colour. Blue, like the other two primary colours, occurs in great purity in some flowers, in the plumage of some birds, and even in portions of the skin of some beasts. But it is found much less frequently in the vegetable and animal kingdoms than either red or yellow.

Amongst minerals, the *lapis lazuli* presents the purest blue that can be conceived, and is converted by a very simple process into an equally beautiful pigment.

## OF THE SECONDARY COLOURS.

**ORANGE.**

Orange colour is the most powerful of the secondaries, and is a compound of yellow and red. Between these two colours it appears in the prismatic spectrum, rainbow, and other natural phenomena. They are, therefore, its melodizing colours, and its contrasting colour is the primary blue. The mixture of red with yellow adds power to the native warmth of the red ; orange is therefore, conjointly in regard to light and colour, most powerful in its effect upon the eye. From its combination with green arises the hue citrine, and with purple that of russet.

Orange colour, like the other two secondaries, has great variety of tone, according to the predominance of either of its component parts. As it passes towards yellow, by a predominance of that colour in its mixture, pure blue no longer forms its proper contrast, but tones of bluish purple advancing towards perfect purple, as the orange colour retires into yellow. On the other hand, when the orange colour advances towards a red-dish tone, bluish-green becomes its proper contrasting colour—the blue approaching the perfect secondary, as the orange approaches the primary.

**GREEN.**

Green is the medial colour of the secondaries, and is a compound of yellow and blue; its melodizing tones being these two primaries, and its contrasting colour red. As red is the most decided and powerful of the primaries, so green is the most neutral and soft of the secondaries, and the most pleasing and agreeable of all decided colours to the eye. It is unlike the other two secondaries in this respect—that, in its approximation to either of its component parts, it produces no other distinct denomination of colour; all its varieties of tone retaining the same name. From the union of green with orange arises the lightest of the hues, citrine; and from that with purple the deepest, olive colour—to which it is particularly allied.

Green is nature's favourite colour, prevailing to a far greater extent in the vegetable kingdom than any other. By a beneficent exercise of the Divine wisdom, it is exhibited in its greatest intensity and depth when the sun's rays are most powerful, thereby counteracting the intensity of their reflection, and refreshing the eye by its soft and soothing influence. Green, however, seldom appears in vegetation in its primitive purity—hence the beautiful accordance between the green of the landscape and the blue of the sky, assisted by the intervention of the warm and neutral gray which prevails in the distance of the one and the horizon of the other.

The effect of green is much deteriorated in artificial light, from the cause already explained in treating of yellow.

### PURPLE.

Purple arises from the union of red and blue, and forms the proper contrast to pure yellow. The two colours of which it is compounded are its melodizing tones. Although red is one of its component parts, purple is retiring in its effect, being the darkest of the secondary colours. In combination with green it produces that soft and useful hue, olive; and with orange the most powerful of this class, russet.

Purple, like the other two compounds, has various tones according to the predominance of one or other of its elements; but these are bounded in its approach to red by crimson, and towards blue by indigo colour. Its tints have also names peculiar to themselves, such as lilac, peach-blossom, French white, &c.

These primary and secondary colours form the full scale of the chromatist, and have all proper names except orange, which is so called from its resemblance to the colour of that fruit. They continually occur in various degrees of intensity in all chromatic spectra produced by the refraction of light, and are therefore properly called colours.

## OF THE TERTIARY COLOURS, OR PRIMARY AND SECONDARY HUES.

Hues are those combinations in which the three elements occur in their full intensity, and in such proportions as give them a distinct character. The three primary hues are those which arise from the combination of the secondary colours with one another. That arising from the combination of orange and green, is called citrine—that from orange and purple, russet—and that from purple and green, olive. Their distinctions arise from a double occurrence of yellow in the first, of red in the second, and of blue in the third. There is a second class of hues, or semi-neutrals, formed by the union of the first class. Thus the mixture of citrine and russet produces a hue having the same relation to orange that citrine has to yellow. That of citrine and olive produces one having the same relation to green that olive has to blue; and that of russet with olive, another having the same relation to purple that russet has to red.

The hue termed neutral gray may be explained as the result of an equal combination of light, shade,

and colour, in which the coldness of the two first is equally balanced with the warmth of the last; and in which, also, the three primaries are equally balanced in regard to their respective powers as colours. The gray produced by the admixture of black and white, is of a different character, having a predominance of blue in its composition, and a consequent coldness of tone.

The Chinese seem to study this in the manufacture of their well-known ink; the finer qualities of which give by dilution the most perfect tints of neutral gray.

OF THE NUMERICAL POWERS AND  
PROPORTIONS OF COLOURS  
AND HUES.

According to the language generally employed by writers upon colour, yellow, red, and blue are said each to absorb a certain portion of the rays of light, and reflect or transmit the remainder. But I cannot consider this doctrine to be correct, while I believe colour to be produced by the joint influence of light and shade, as already mentioned. We know that fire is produced by combustion, and that the active agent is oxygen, and the passive agent the body consumed, by which joint operation fire is produced. In like manner, light is the active and darkness the passive agent in the production of colour; and each of the primaries is thus the effect of the principles of light and darkness acting together upon the visual organ, and producing by their joint operation a colour.

As I shall require, in elucidating the various modes of combining the primaries, to subdivide them, I shall take 360 as the joint power of light and darkness, giving to each 180. These two powers, when acting together in their simplest mode, mutually neutralize each other in the production of gray, which is in power to light as 90, and in power to the opposite principle also as 90, or in the ratio of 1 to 2 to each of its constituents, or conjointly as 180 to 360.

Out of this combination of light and darkness, the phenomenon of colour seems to arise by a different mode of action; and these two principles are apparently embodied in each of the simple elements of colour in the following proportions:—

	Relation to Light,	Relation to Darkness.	Total.	Power as a Colour.
Yellow,	45	15	60	30
Red,	30	30	60	30
Blue,	15	45	60	30
Neutralized to Gray, 90	—	—	—	—
		90	180	90

Their action is, therefore, collectively either as to light or darkness, similar to that of neutral gray, and the mean power of each arising out of the mutual action of these two opposite principles will be, as a colour simply, 30.

Red, it will be observed, is the most perfect colour, from its relation to light and shade being equal, the two principles acting in it in similar ratio to that which produces neutral gray, but in a different and more vigorous mode.

The secondary colours arise from the combination of these primaries; and by this union one primary neutralizes another in the production of each of the secondaries. Merely as colours, therefore, their relative powers to the primaries might be reckoned as 1 to 2, or 15; but in the process of combination, we must consider the powers of the primaries united, and the quantity thus doubled, so that the powers of the colours and hues decrease in the inverse ratio to the numbers produced by their com-

bination, in the same manner that the number of vibrations produced by a monochord is always in the inverse ratio to its length. The secondary colours are consequently reckoned thus:—

	Relation to Light.	Relation to Darkness.	Total.	Colour.
Yellow,	45	15	60	30
Red,	30	30	60	30
Orange,	75	45	120	60
Yellow,	45	15	60	30
Blue,	15	45	60	30
Green,	60	60	120	60
Red,	30	30	60	30
Blue,	15	45	60	30
Purple,	45	75	120	60

The powers of the primary and secondary colours in neutralizing each other, are, according to the relations they individually bear to light and darkness, thus:—

	Relation to Light.	Relation to Darkness.	Total.	Colour.
Yellow,	45	15	60	30
Purple,	45	75	120	60
Neutral Gray, 90		90	180	90
Red,	30	30	60	30
Green,	60	60	120	60
Neutral Gray, 90		90	180	90
Blue,	15	45	60	30
Orange,	75	45	120	60
Neutral Gray, 90		90	180	90

The neutral gray being produced by the proportionate combination of the primaries.

The hues arise from the pairing of the secondary colours, and consequently the primary triad are united in their composition in various proportions, thus:—

	Relation to Light.	Relation to Darkness.	Total.	Colour.
Orange,	75	45	120	60
Green,	60	60	120	60
Citrine,	135	105	240	120
Orange,	75	45	120	60
Purple,	45	75	120	60
Russet,	120	120	240	120
Green,	60	60	120	60
Purple,	45	75	120	60
Olive,	105	135	240	120

As the secondary colours have been shown to be neutralized by the primaries, so the tertiaries, or hues, are neutralized by the secondaries, thus:—

	Relation to Light.	Relation to Darkness.	Total.	Colour.
Citrine,	135	105	240	120
Purple,	45	75	120	60
Neutral Gray,	180	180	360	180
Russet,	120	120	240	120
Green,	60	60	120	60
Neutral Gray,	180	180	360	180
Olive,	105	135	240	120
Orange,	75	45	120	60
Neutral Gray,	180	180	360	180

The neutral gray being produced by the proportionate combination of the primary colours in double quantity. In each of these three hues the primary colours occur in the following proportions :—

	Citrine.	Russet.	Olive.
Yellow,	60	30	30
Red,	30	60	30
Blue,	30	30	60

By which it will be seen that the yellow is doubled in citrine, the red in russet, and the blue in olive. Citrine is therefore the natural shade of yellow, russet of red, and olive of blue.

The union of these hues in pairs, produce the secondary class called semi-neutrals, which, in like manner, form the proper shades to the secondary colours, thus :—

	Relation to Light.	Relation to Darkness.	Colour.
Citrine,	135	105	120
Russet,	120	120	120
Orange hue,	255	225	240
Citrine,	135	105	120
Olive,	105	135	120
Green hue,	240	240	240
Olive,	105	135	120
Russet,	120	120	120
Purple hue,	225	255	240

These hues or shades, like the secondary colours, are each neutralized by one of the primaries, thus :—

	Relation to Light.	Relation to Darkness.	Colour.
Orange hue,	255	225	240
Blue,	15	45	30
Neutral Gray,	270	270	270
Green hue,	240	240	240
Red,	30	30	30
Neutral Gray,	270	270	270
Purple hue,	225	255	240
Yellow,	45	15	30
Neutral Gray,	270	270	270

The neutral gray being produced by the proportionate mixture of the primary colours in triple quantity.

They are likewise neutralized by the addition of one of the primary hues, thus:—

	Relation to Light.	Relation to Darkness.	Colour.
Orange hue,	255	225	240
Olive,	105	135	120
Neutral Gray,	360	360	360
Green hue,	240	240	240
Russet,	120	120	120
Neutral Gray,	360	360	360
Purple hue,	225	255	240
Citrine,	135	105	120
Neutral Gray,	360	360	360

The neutral gray being produced by the proportionate mixture of the three primary colours in quadruple quantity.

The primaries are united in the semi-neutrals as follows:—

Orange Hue.	Green Hue.	Purple Hue.
Yellow, 90	Yellow, 90	Yellow, 60
Red, 90	Red, 60	Red, 90
Blue, 60	Blue, 90	Blue, 90

Hence it will be seen that the primary colours are trebled in these, except blue in the orange hue, red in the green hue, and yellow in the purple hue, in which these colours are double only. These hues, as just observed, are the natural shades of orange, green, and purple respectively, as the other hues are of yellow, red, and blue; because each holds in its composition the elements of one of those secondary colours, combined with those of neutral gray.

## OF THE RELATIVE POWERS OF COLOURS AND HUES.

As already observed, the powers of these colours and hues decrease in an inverse ratio to the increase of the elements which unite in their combinations. Thus green appears to be to red as sixty to thirty, but having only half the power of either of its constituent parts, and being doubled in quantity in the process of combination here adopted, it is to red in power as fifteen to thirty, or in the ratio of one to two. Therefore, simply considered as colours, and without reckoning upon their relations to light or shade, each primary colour is to a secondary in power as 2 to 1; to a secondary hue as 4 to 1, and to neutral gray as 6 to 1. Each secondary colour is in power to a hue as 2 to 1, and to neutral gray as 3 to 1. The primary hues are to gray as 3 to 2, and the secondary hues are to gray as 6 to 5, or nearly so.

Indeed, independently of the relations of colours to light and darkness, the harmonic ratios operate upon them in the production of full tones, semi-tones, and quarter-tones, as distinctly as they do upon the notes in the scale of the musician; and, if these ratios were properly studied in connexion with this subject, it would enable the student in art to impart, with perfect

certainty, harmony to his works, and the amateur to understand and appreciate what is harmonious in colouring.

As the powers of the colours and hues already enumerated are relative to one another, and as, by their being placed in juxtaposition, various modes of contrast or harmony are produced, I have given in Plates I., II., III., and IV., four of those modes, the principle exhibited in which will equally apply to all the tints and shades given in the sequel.

In Plate I., red is opposed to green, yellow to purple, and blue to orange, in Figures 1 and 4, 2 and 5, 3 and 6. Of these contrasts the most perfect is red and green, the former being equally allied to light and darkness, and the latter arising out of the combination of yellow and blue, colours related to the principles of light and darkness in equally opposite ratios, these principles being thus reciprocally neutralized in the combination. The contrast between yellow and purple, although less perfect, is more powerful, because their relations to light and darkness operate along with their opposition as colours—the former relating to light as 45, and the other to shade as 75. In like manner, the contrast between blue and orange has relation to light and darkness—the former relating to light as 15, and the other to darkness as 45. Hence we find, throughout all nature's colouring, a predominance of the most perfect contrast—red and green—and this in every conceivable variety and mode.

In Plate II., russet is opposed to green, citrine to purple, and olive to orange, in Figures 1 and 4, 2 and 5, 3 and 6.

In Plate III., green hue is opposed to red, orange hue to blue, and purple hue to yellow, in Figures 1 and 4, 2 and 5, 3 and 6.

This mode of contrast is pleasing, and at the same time powerful, because the one colour being subdued by shade, gives additional brilliancy to the other without harshness of opposition.

In Plate IV., russet is opposed to green hue, citrine to purple hue, and olive to orange hue, in Figures 1 and 4, 2 and 5, 3 and 6. This last is the lowest and weakest of these modes of contrast, and its effect in all the varieties of light and shade is soft and delicate.

In mixing the primary colours, without the further assistance of the representatives of light and darkness—black and white—than what naturally enters into their constitution, distinction seems to cease with the semi-neutrals. It will, therefore, be requisite next to employ these representatives in the production of a series of tints and shades, arising out of the fluxional power which they exercise upon colours and hues; at the same time, showing the effect produced upon the secondary colours by a predominance of one or other of their constituent parts. In this a system of intervals must be adopted, by which the innumerable intermediate varieties may be understood.

It is by the operation of light and shade upon colours,

that the most beautiful effects of contrast and blending in nature and art are produced. It has just been shown that green is the most powerful contrast to red, orange to blue, and purple to yellow, when these colours are in their full intensity. But when they are reduced to tints by the admixture of white, or to shades by that of black, a perfect contrast can only be produced by opposing those two representatives of light and darkness to one another. Dark green is therefore the most powerful contrast to light red, dark orange to light blue, and dark purple to light yellow—the shade partaking equally of black as the tint does of white. Yet beauty does not always consist in such contrasts, no more than it does in those of intense colours, but often in the more graduated or intermediate. For instance, a tint of pure red, such as rose colour, is enhanced by being contrasted with a tint of impure or neutralized green, and the harmony thereby rendered more soft and pleasing; and the same principle prevails throughout all the colorific scale. But as I wish to give, in connexion with the nomenclature, merely a general idea of the harmony of colour, the tints and shades will, in the first place, be arranged upon the Plates in the fullest power of contrast, being the mode best adapted to convey a correct idea of their relative power.

## OF THE NAMES OF COLOURS AND HUES.

Before proceeding to reduce the colours and hues to tints and shades by the admixture of white and black, it will be requisite to come to a distinct understanding regarding their names. Red, yellow, blue, and green, are the only colours the names of which are clearly understood. The first is derived from the Saxon *red*, and Welsh *rhud*; the second from the Saxon *zealepe*, and Dutch *gheleuwe*; the third from the Saxon *blaep*, and French *bleu*; and the fourth from the German *grun*, and Dutch *groen*. The secondary colour produced by the union of red and blue, has also its proper name, but its application is far from being uniform. It is purple—a name derived from that of a shellfish called *purpura*, from which this colour was extracted by the ancient Tyrians, in the neighbourhood of whose celebrated city this peculiar shellfish was found. To this colour the term violet is very generally applied; and by Goethe, in his excellent “Theory of Colours,” it is often called blue-red, or red-blue, according to the predominance of one or other of its component parts; while to pure red, he and some other writers apply the term *purpur*. There is no reason, however, for depriving this particu-

lar colour of its proper name, and substituting that of a flower, or for applying that name to any other colour ; it is therefore here retained, and confined exclusively to that mixture of red and blue in which these two primary colours are equally balanced. The name of the remaining secondary colour, which arises from the equally balanced union of red and yellow, is well known to be derived from the fruit of the orange-tree. Goethe almost uniformly applies the terms red-yellow, or yellow-red to this colour. But although I have the same objection to this name that I have to violet, or any other name derived from a natural object of which there are variously coloured specimens, I will continue to use it, in default of a better, in preference to the descriptive one of red-yellow. It will be requisite in the sequel to distinguish the varieties of the secondary colours, by naming with them one of their constituent parts ; as yellow-green, blue-green, red-purple, blue-purple, &c., thus indicating a predominance in the compound of the primary colour named. But such a freedom cannot be properly used with a primary colour ; for no sooner is another primary mixed with it, than a secondary colour is produced, and we might as well apply to green the terms yellow-blue, or blue-yellow, as to orange yellow-red, or red-yellow, or to purple red-blue, or blue-red ; and consequently specific names must be adopted for the secondary as well as the primary colours. By this means, also, a better understanding of the innume-

rable hues, tints, and shades, to which they may be reduced, will be arrived at, than by a constant repetition of the names of the primary elements.

A terminology of this kind might, however, with perfect propriety, be applied to the hues arising from the six tertiary combinations of the primaries; because they are simply those colours in single or double occurrence, combined with as many more proportions as constitute neutral gray—consequently citrine might be called yellow hue, russet, red hue, and olive, blue hue; but the names here adopted are preferable, being more specific. These names were, I believe, first applied to the primary hues by Field in his valuable work on colour, “Chromatology.” The names citrine and russet are proper, the first being derived from the Latin *citrinus*, and the second from the Latin *rusus*, or French *rousset*; but the name olive, like orange, is taken simply from the fruit of the olive-tree, the colour of which it resembles.

To the other three hues I have in a former work given the names brown, marrone, and slate; but each of these are shades which, in the sequel, will be shown to arise from the introduction of black, and the terminology is therefore inaccurate. Orange hue, green hue, and purple hue, though less specific, are more appropriate according to the present view of the subject, and are consequently here adopted.

Gray, as has already been observed, is the union of the three primaries, by which they neutralize each

other, and it cannot therefore be properly termed a colour. The term is derived from the Saxon *graeg*, and Danish *grau*, or French *gris*.

Brown is the only other colour beside black and white that has a proper name; it is uniformly a tertiary compound or hue in shade, in which red and yellow predominate, as shall afterwards be shown. The term is derived from the Saxon *bran*.

The terms white and black, applied to the representatives of light and darkness, are from the Saxon *þpig*, or Dutch *wit*, and from the Saxon *blac*, respectively.

The only proper names amongst colour are therefore red, yellow, blue, green, purple, citrine, russet, and brown; with white, gray, and black, for light, shade, and darkness. Red has, no doubt, two other varieties to which proper names have been given—namely, crimson and scarlet; the first being the admixture of red with a small proportion of blue, and the second being the same with a small proportion of yellow, as shall be pointed out in the sequel. But they approach in appearance so near the primary colour, that their names are often used as a general term for red. The term crimson is derived from the Italian *crimosino*, and that of scarlet from the French *escarlate*.

## OF THE NAMES OF COLOURS IN HERALDRY.

According to ancient practice in the science of heraldry, there were only five tinctures, as they are called in its peculiar language, acknowledged as the proper armorial colours, viz. white and black, and the three primary colours, red, yellow, and blue. In the reign of Richard II. green was added, and, about the middle of the sixteenth century, purple. The nomenclature of heraldic colouring is all but uniform over Europe, and is as follows :—

*Argent*—Silver or white, from the Latin *Argentum*, silver.

*Or*—Gold or yellow, from the French name for gold.

*Gules*—Red, from the Latin *Gula*, the throat, or Arabian word *Gules*, meaning a red rose.

*Azure*—Blue, from the Arabic or Persian name of that colour, *Lazurd* or *Lazurion*.

*Vert*—Green, the French name for that colour; although in this science it has been supplanted in that country by the term *Sinople*, taken from the name of a town in the Levant, from whence the best green dye-stuff was brought.

*Purpure*—Purple, from the name of a shellfish, as already noticed.

*Sable*—Black—either from the black fur of that name, or from the French name for sand or earth.

At a more recent period, other two colours were introduced into heraldry, called *tenney* and *sanguine*. These correspond to orange and russet; the first being composed of red and yellow, and the other being described as a *dusky* red. But the use of these colours in heraldry has been almost exclusively confined to the Dutch and Germans, and they are of course little known in English blazonry.

It would thus appear, that at the period of the introduction of heraldry, the three primary colours, only, were used along with the representatives of light and darkness, white and black.

## OF POPULAR NAMES OF COLOURS.

There are, besides those already noticed, numerous popular names for colours, hues, tints, and shades, which, like orange and olive, are derived from familiar objects, and are therefore perfectly understood. Of this kind are straw-colour, lilac, primrose, pink, or rose-colour; others are as distinctly expressed by an adjective. Of these, sage green, pea green, azure blue, indigo blue, saffron yellow, are examples. This popular mode of nomenclature is so well established, and so generally understood, that it would perhaps be quite useless to attempt to supersede it by one of a more scientific nature. These and various other popular names shall therefore be pointed out as they occur in the systematic mode of combination, augmentation, and reduction of the various elements of the chromatic scale here adopted. But the ephemeral nomenclature of fashion, in which we find Mazarine blue, Esterhazy gray, &c. &c., shall be altogether set aside, because it has no specific meaning, and can only mislead.

The horse has been honoured with the application of an exclusive nomenclature of colour to himself. In this of course is included the general terms, black, white, and gray. But chestnut, bay, sorrel, and roan,

belong exclusively to the horse, and are as names of colours applied to no other objects, either animate or inanimate, with the exception of the first, which is sometimes applied to the human hair. A carriage drawn by a pair of chestnuts, a pair of bays, or a pair of roans, is as well understood to mean that it is drawn by horses, as if the noun followed the adjective. But, however much any part of male or female attire may resemble the colour of the chestnut, or that of a bay, roan, or sorrel horse, the term is never applied—some other name is always given. These colours shall be pointed out as they occur in the combinations which follow ; but neither roan nor sorrel are, properly speaking, colours, but mottled mixtures of black, chestnut, or bay, with gray or white spots or hairs, and therefore cannot be represented by a solid colour.

## OF TINTS AND SHADES.

In what follows, the relative powers of the six colours as to light and darkness, must be left to be understood from the explanations already given, and their effects as colours alone considered. Each colour shall, therefore, be understood to be in power as 30 in its action upon white, gray, or black, and the reciprocal action of these modifiers to be in like manner 30. These powers shall be so divided, that the intervals between the tints and shades shall be in the same proportion as that between the primary colours, yellow, red, and blue, in their relations to light and darkness; namely, in the numerical progression of 1, 2, 3, of the colour acted upon.

I adopt these wide intervals, not only as being the course indicated by the natural laws of the phenomenon itself, already pointed out; but because the exhibition of a closer series of tints and shades, would multiply the examples to an extent beyond the limits of a work of this nature.

Plate V. exhibits three tints produced by red, and three shades produced by green, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Red,	5	10	15	Green,	5	10	15
White,	15	10	5	Black,	15	10	5

The tint Figure 1, and the shade Figure 4, produce a perfect contrast, the one being allied to light in the same proportion that the other is to darkness; so are Figures 2 and 5, and 3 and 6. This mode shall be continued in those examples that refer to the tints and shades of positive colours; but a different system of contrast will be adopted in such as are produced by the reduction of the hues. The tints of pure red are all pale or deep pinks, or rose-colours, and their varieties are simply pale or deep, until they lose their distinction in pinkish white on the one hand, or light red on the other; but to specify precisely the point at which either of those changes takes place, would be equalled in difficulty only by its inutility.

The darker shades of green have various popular names, amongst which are myrtle green, sea green, bronze green, &c.; but as these are modified otherwise than by a simple reduction to shade, they will occur in other examples.

Plate VI. exhibits three tints of green, and three shades of red, as follows:—

Figures,	1	2	3		Figures,	4	5	6
Green,	—	—	—		Red,	—	—	—
White,	5	10	15		Black,	5	10	15

In this plate, it will be observed that the contrasts are upon the same principle as the preceding, but reversed as to tints and shades.

In the popular nomenclature of colours, the tints of green have a greater number of appellations than those

of any other colour, as will be observed in the sequel. But the only one of these that can be applied to a pure tint of this colour, with the exception of light or pale green, is the well-known one of pea-green, (Figure 1;) all the others being modified either by the predominance of one of their constituent parts, or by their being gently neutralized with red.

The lighter shades of red are popularly denominated marrone colour, (Figure 6,) and its deeper shades chocolate colour; although the latter is more perfect when slightly modified by yellow.

Plate VII. exhibits tints of yellow, and shades of purple, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Yellow,	—	—	—	Purple,	—	—	—
White,	5	10	15	Black,	5	10	15

The only popular name for a light tint of pure yellow, is primrose, a lighter tint than Figure 1. The deeper tints are generally called straw colours. To shades of purple, the terms violet and indigo are generally applied, although the latter is more properly a shade of blue. But the term violet is here quite applicable, as that flower exhibits in its numerous varieties every shade of purple down to black.

Plate VIII. The order of the foregoing plate is here reversed, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Purple,	—	—	—	Yellow,	—	—	—
White,	5	10	15	Black,	5	10	15

Lilac is the popular name for a light tint of purple; and the adjectives deep and pale are generally applied until it reaches light purple on the deep side, and the well-known tint French white on the pale side.

The shades of yellow, from the predominance of blue in black, are green, and may be termed yellowish olive, but they produce no distinct hue having a popular name.

Plate IX. exhibits three tints of blue, and three shades of orange, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Blue,	—	—	—	Orange,	—	—	—
White,	5	10	15	Black,	5	10	15
	15	10	5		15	10	5

The most popular name for a tint of blue is the heraldic term azure, meaning simply light blue, but of no specific degree of intensity. Ethereal or sky blue, is another name for tints of this colour.

The shades of orange which accompany these tints are browns, Figure 6 being the most perfect.

In Plate X. these colours are reversed in regard to light and shade, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Orange,	—	—	—	Blue,	—	—	—
White,	5	10	15	Black,	5	10	15
	15	10	5		15	10	5

Salmon colour is the name usually given to such tints as those produced by the attenuation of orange.

Indigo is the only popular name applied to a shade of blue, and is derived from the dye-stuff of that name.

It has already been observed, that the secondary colours are subject to such modifications as arise from an excess of one or other of the primary colours, of which they are respectively composed. These modifications shall now be given in similar intervals to those of the tints and shades just described, and similarly contrasted.

Plate XI. exhibits three varieties of red orange opposed to as many of blue green, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Orange,	—	—	—	Green,	—	—	—
Red,	5	10	15	Blue,	15	10	5
	15	10	5		5	10	15

Red orange has no specific name until it reaches scarlet, of which colour Figures 1, 2, and 3, are varieties.

Sea green is the name popularly applied to a green in which blue predominates; but this element is liable to so many changes of hue, that it would be difficult to point out one even as its general characteristic colour. Figure 4 is the tone of green generally termed myrtle.

Plate XII. exhibits yellow orange and blue purple, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Orange,	—	—	—	Purple,	—	—	—
Yellow,	5	10	15	Blue,	15	10	5
	15	10	5		5	10	15

This modification of these two colours gives rise to no colour having another name except Figures 1 and 2, which are the tones of yellow generally called amber colour. The blue purples are varieties of violet.

Plate XIII. exhibits yellow green and red purple, as follows :—

Figures,	1	2	3	Figures,	4	5	6
Green,	—	—	—	Purple,	—	—	—
Yellow,	5	10	15	Red,	15	10	5

Pomona green is the popular name of all full-toned greens in which yellow predominates. This of course means the colour of an apple, and consequently admits of ample latitude as to variety of tone.

Crimson is the characteristic colour of red purples, of which Figures 1, 2, and 3, are varieties. The name, as already observed, is derived from the Italian *crimino*, and is sometimes applied to red in general. It is a favourite colour in all kinds of decoration, and derives its beauty from being the warmest and most positive of colours, mellowed by a slight infusion of the most negative and cool.

To reduce each of these modifications of the secondary colours to tints and shades, would too much extend the number of examples without producing any very distinct varieties. I shall therefore only reduce those that occur intermediately from the equal proportions of the primaries and secondaries, in Figures 2 and 5 of each of the three foregoing plates, to which the terms

red orange, yellow orange—blue green, yellow green—red purple and blue purple, shall be applied.

Plate XIV.—

Figures,	1	2	3	Figures,	4	5	6
Red orange, or scarlet, White,	5	10	15	Blue green,	5	10	15
	15	10	5	Black,	15	10	5

To light tints of scarlet, flesh-colour is generally applied; but the shades of blue green have no specific popular name; and from this tone of green being so allied to black, it is almost concealed when mixed in the specified proportions, unless brought out, as it may be, by being placed in juxtaposition to an equally deep shade of red.

Plate XV.—

Figures,	1	2	3	Figures,	4	5	6
Blue green,	5	10	15	Red orange,	5	10	15
White,	15	10	5	Black,	15	10	5

The lightest of these tints is generally called turquoise green, from the stone of that name, and the two deeper tints resemble the peculiar green of verdigris, but without its brilliancy.

The shades of red orange produce those warm-toned browns generally denominated chestnut, auburn, &c. The first of these names is derived from the well-known nut so called, and the other applied popularly, as well as by many authors, to a peculiar colour of the human hair; but from what originally derived it is difficult to say, unless, probably, it be a corruption of brown.

## Plate XVI.—

Figures,	1	2	3	Figures,	4	5	6
Yellow orange,	5	10	15	Blue purple,	5	10	15
White,	15	10	5	Black,	15	10	5

The lightest of these tints (Figure 1) is what is popularly termed deep cream colour. The other two tints are varieties of amber colour.

The shades of blue purple are varieties of violet colour.

Plate XVII. In this plate the order of the foregoing is reversed:—

Figures,	1	2	3	Figures,	4	5	6
Blue purple,	5	10	15	Yellow orange,	5	10	15
White,	15	10	5	Black,	15	10	5

The tints of blue purple are varieties of lilac. The lightest shade (Figure 6) of yellow orange produces the deepest tone of that species of brown called dun; the other two approach the olive hue, but are of a warmer tone.

In Plate XVIII. are given tints of yellow green and shades of red purple, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Yellow green,	5	10	15	Red purple, { or crimson, }	5	10	15
White,	15	10	5	Black,	15	10	5

These tints are simply varieties of pomona green.

The lightest of the shades of red purple (Figure 6) is what is usually called a deep marrone. This term

I have already used, but can give no account of its derivation. The shades, however, to which it is applied, have a distinct character, and are amongst the most useful of the deep tones in several kinds of manufacture; they are therefore, as a class, entitled to a specific name.

Plate XIX. exhibits the foregoing arrangement reversed, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Red purple,	5	10	15	Yellow green,	5	10	15
White,	15	10	5	Black,	15	10	5

The lightest of these tints is what is generally termed peach-blossom, from its resemblance to that flower; its deeper tints have no specific character until they reach the depth of light crimson.

The shades of yellow green are of a soft and mellow character, but have no other names than dark pomona or olive.

It will be observed throughout the foregoing examples, that the most agreeable contrasts arise from the colours most allied to shade being diluted to tints, and those most allied to light being reduced to shade, of which Plate XIX. is one of the most pleasing examples. It will likewise be observed, that all the colours in which blue predominates, become almost obscured in the deepest shades, although they form one-fourth of the composition. But this effect is not to be wondered at, considering that blue itself is related to black

or darkness, in the ratio of one to two. Even yellow, the colour most allied to light, is almost obscured in the deepest shades. Although a certain degree of variety would be produced by a reduction of the hues with black, yet it would be so slight as only to be discernible when such shades were placed in juxtaposition with equally deep shades of opposite colours, and it would therefore be useless to give any examples of this kind. Indeed, the hues themselves are a medial class between colours and shades, being equally allied to the principles of light and darkness in three-fourths of their component parts, as already shown. But when attenuated by white, they assume a very different character, and produce many beautiful tints. They may also, like the secondaries, be varied by an approximation to one or other of their constituent parts, and these varieties, likewise, will each form a series of beautifully modified tints.

In Plate XX. is given the first of this series of neutralized tints, and exhibits russet and green hue reduced, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Russet,	—	—	—	Green hue,	—	—	—
White,	5	10	15	White,	5	10	15

These tints are simply modifications of red and green, such as are produced in nature by the interpolation of the atmosphere between the foreground and distance of the landscape.

This mode of reducing colours, by their admixture with the elements of neutralization in mathematical progression, might, I have no doubt, be employed with advantage in fixing the relative powers of colours at certain points, corresponding to other points in the linear perspective of a picture.

For instance—in a battle piece, where, upon a certain area, numerous bodies of military are represented, the relative difference of size between those in the foreground, extreme distance, and various intermediate situations, must have a perfect mathematical proportion to one another, corresponding to the relative positions they occupy in the area upon which they are placed, and this can only be done correctly by an adherence to the precise rules of linear perspective—and the application of these rules is the only mode of testing the accuracy of such a work; so also should the relative strength of the colours which distinguish these figures, whether in light or shade, be mathematically proportioned to their situations in the picture.

I am well aware, that after the artist has studied carefully the rules of linear perspective, he does not require to do more than fix a few points between the foreground and extreme distance of his picture, by the systematic application of these rules—filling up all intermediate parts by the eye alone. No such aid, however, has been made available, even to this extent, in colouring; and consequently the eye alone has been the guide. But if a systematic rule be of service in

the one case, it must be so in the other; and the attainment of a knowledge of the mathematical gradations by which a positive colour is made apparently to retire, will be as useful to the student as that of linear perspective, when applied to a series of figures, trees, or columns, in a picture. It is, no doubt, requisite in all cases to make allowance for the kind of atmosphere in which the objects in a picture are represented. But this may be done without violating the rules of gradation, or altering the relations of the tints; for it only affects their general tone or mode of retiring, in the same manner that the situation of the point of distance extends or shortens the space occupied by a colonnade in linear perspective.

In Plate XXI. this series of neutralized tints is continued, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Citrine,	5	10	15	Purple hue,	5	10	15
White,	15	10	5	White,	15	10	5

The tints of citrine are generally denominated drab, or, more properly, tawny colours. Those of purple hue are a close approximation to the true or colourless gray, produced by the admixture of black and white, the small proportion of red and yellow which they bear being almost obscured.

Plate XXII. completes the series, as follows:—

Figures,	1	2	3	Figures,	4	5	6
Olive,	5	10	15	Orange hue,	5	10	15
White,	15	10	5	White,	15	10	5

The lightest tint of olive (Figure 1) is a perfect sage green; one of the most pleasing varieties, or rather modifications, of that secondary colour. The two lightest tints of orange hue are what are properly termed fawn colours; the deepest is a warm brown, or light chestnut colour, approaching what is technically termed bay in the colour of a horse.

The hues are a very important class in the colorific circle, and, like the secondary colours, are subject to various modifications by a predominance of one or other of their constituent parts. These modifications carry them, on the one hand, towards the colours of which they are the natural shades, and on the other, towards their common constituent—neutral gray. In the first case they are simply modifications of the six positive colours; and the terms, tempered red, tempered green, &c., are very appropriate. In the second case, they are modifications of the six positive hues, and may consequently be called tempered russet, tempered green hue, &c. Russet itself is no doubt tempered red, but it is so in that intermediate ratio which produces this peculiar hue.

The three following Plates exhibit the primary and secondary colours thus modified at three points between the pure state and the tertiary hue, as follows:—

Plate XXIII.:—

Figures,	1	2	3	Figures,	4	5	6
Red,	—	—	—	Green,	—	—	—
Russet,	15	10	5	Green hue,	15	10	5
	5	10	15		5	10	15

## Plate XXIV.:-

Figures,	1	2	3	Figures,	4	5	6
	—	—	—		—	—	—
Yellow,	15	10	5	Purple,	15	10	5

Citrine,	5	10	15	Purple hue,	5	10	15
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## Plate XXV.:-.

Figures,	1	2	3	Figures,	4	5	6
	—	—	—		—	—	—
Blue,	15	10	5	Orange,	15	10	5

Olive,	5	10	15	Orange hue,	5	10	15
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The contrasts produced by these tempered colours are of a soft and pleasing character, and the colours themselves seem to possess, by this process, that intrinsically mellow tone so much admired in the works of the best colourists of antiquity.

The next three Plates exhibit the six colours as they appear at three points between their occurrence in the tertiaries or hues, and their perfect neutralization in gray, as follows.

## Plate XXVI.:-

Figures,	1	2	3	Figures,	4	5	6
	—	—	—		—	—	—
Russet,	15	10	5	Green hue,	15	10	5

Gray,	5	10	15	Gray,	5	10	15
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## Plate XXVII.:-

Figures,	1	2	3	Figures,	4	5	6
	—	—	—		—	—	—
Citrine,	15	10	5	Purple hue,	15	10	5

Gray,	5	10	15	Gray,	5	10	15
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## Plate XXVIII.:—

Figures,	1	2	3	Figures,	4	5	6
Olive,	—	—	—	Orange hue,	—	—	—
Gray,	15	10	5	Gray,	15	10	5
	5	10	15		5	10	15

Thus we have of each of the six colours a series of seven modifications, producing forty-two distinct hues, in each of which the whole colorific circle or scale is combined. For example, take red, of which we have the first modification in Plate XXIII., Figure 1.

The second in the same Plate, Figure 2.

The third in the same Plate, Figure 3.

The fourth in Plate II., Figure 1, (russet.)

The fifth in Plate XXVI., Figure 1.

The sixth in the same Plate, Figure 2; and

The seventh in the same Plate, Figure 3.

Of these modifications, the fourth of each of the colours has already been reduced to tints by three degrees of attenuation of the hues with white in Plate XX., XXI., and XXII.

In the three Plates that now follow, the second modification is similarly reduced.

## Plate XXIX.:—

Figures,	1	2	3	Figures,	4	5	6
Tempered red, 5	—	—	—	Tempered green, }	—	—	—
White, 15	10	15	5	White,	5	10	15
	15	10	5		15	10	5

## Plate XXX.:-

Figures,	1	2	3	Figures,	4	5	6
Tempered yellow,	{ 5	10	15	Tempered purple,	{ 5	10	15
White,	15	10	5	White,	15	10	5

## Plate XXXI.:-

Figures,	1	2	3	Figures,	4	5	6
Tempered blue,	{ 5	10	15	Tempered orange,	{ 5	10	15
White,	15	10	5	White,	15	10	5

The delicate beauty imparted to the positive colours by the neutral gray, becomes more apparent when they are reduced to tints, as shown in these examples.

In the next three Plates are given the tints arising from the sixth modification of the positive colours, producing what are usually termed warm and cool-toned grays, as follows.

## Plate XXXII.:-

Figures,	1	2	3	Figures,	4	5	6
Reddish gray,	{ 5	10	15	Greenish gray,	{ 5	10	15
White,	15	10	5	White,	15	10	5

## Plate XXXIII.:-

Figures,	1	2	3	Figures,	4	5	6
Yellowish gray,	{ 5	10	15	Purplish gray,	{ 5	10	15
White,	15	10	5	White,	15	10	5

## Plate XXXIV.:-

Figures,	1	2	3	Figures,	4	5	6
Bluish gray,	{ 5	10	15	Orange gray,	{ 5	10	15
White,	15	10	5	White,	15	10	5

These tints almost lose their relation to the primary which predominates in them, being deduced from that modification which, with the exception of the seventh, is the closest systematic approximation to the perfect neutral gray of which the positive colours are susceptible.

It would be observed, that in subduing the six colours to shade by their admixture with black, in the same ratios as were employed in attenuating them to tints by white, they became obscured at five of colour to fifteen of black, or when the colour was to the black as 1 to 3; but that on the light side, when the colour was to white in the same ratio, it appeared in considerable power. I have therefore added the six following Plates, in which these colours and their corresponding tertiaries are still further attenuated with white. In this a different mode of gradation has necessarily been adopted, in which the intervals are as follows.

### Plate XXXV.:—

Figures,	1	2	3	Figures,	4	5	6
Red,	1	2	3	Green hue,	1	2	3
White,	15	15	15	White,	15	15	15

### Plate XXXVI.:—

Figures,	1	2	3	Figures,	4	5	6
Yellow,	1	2	3	Purple hue,	1	2	3
White,	15	15	15	White,	15	15	15

## Plate XXXVII.:—

Figures,	1	2	3	Figures,	4	5	6
Blue,	1	2	3	Orange hue,	1	2	3
White,	15	15	15	White,	15	15	15

## Plate XXXVIII.:—

Figures,	1	2	3	Figures,	4	5	6
Green,	1	2	3	Russet,	1	2	3
White,	15	15	15	White,	15	15	15

## Plate XXXIX.:—

Figures,	1	2	3	Figures,	4	5	6
Purple,	1	2	3	Citrine,	1	2	3
White,	15	15	15	White,	15	15	15

## Plate XL.:—

Figures,	1	2	3	Figures,	4	5	6
Orange,	1	2	3	Olive,	1	2	3
White,	15	15	15	White,	15	15	15

Amongst these tints, that of the rose, the primrose, and the lilac, are the most decided of those that arise from the reduction of the positive colours. The light tints of the hues are of a delicate and retiring character, but have no specific denomination. Yet, as they bear the same relation in point of contrast to the tints of the positive colours with which they are associated, as that exhibited between the colours and hues in Plates II. and III., they will be found useful in all light arrangements, whether employed as contrasting or melodizing colours.

To have completed this system of colours, one hundred and forty-four additional examples of tints and shades should have been given ; but such an addition would have rendered the book too expensive for many of the classes for whose use it is intended. I shall, however, here point out the tints and shades omitted, in order that the practical artist may be enabled to complete the series when applying this system to his works.

It will be observed in Plates XI., XII., and XIII., that each of the secondary colours are subjected to six systematic modifications, from each of which a series of tints and shades ought to be produced. But the examples have been confined to the reduction of two of those modifications only ; namely, Figures 2 and 5 of each plate. This, however, is sufficient to point out the mode by which the remaining seventy-two examples may be systematically produced in practice.

It has also been shown (p. 53) that the six positive colours—red, yellow, blue, green, purple, and orange—have each seven systematic modifications between their positive and negative states, each of which may be reduced to a series of distinct tints. But the second, fourth, and sixth only, have been so exhibited in the examples, leaving the seventy-two tints which would arise from the attenuation of the intermediate hues, to be understood from these by the practical artist. So also might the lighter tints of the colours and hues, shown in the last six Plates, be systematically reduced to reddish white, greenish white, French white, cream white, &c. &c. ; but these

tints have been omitted for the reasons already adduced.

In the practical application of this system to the purposes of art and manufactures, therefore, these omissions will occasion but little inconvenience. They may, however, be more felt by the naturalist, the botanist, and the professor of anatomy, in applying it to descriptions of the objects of their respective studies. Yet enough has been given to enable any one, by a little attention, to perceive to what class any colour, hue, tint, or shade, belongs, and to name its character and position in the series, whether exhibited in the examples or not. Little apology, however, is called for on account of this limitation in the examples, considering that they already amount to upwards of double the number given in any similar attempt that has yet been made, and that it is the only nomenclature in which a system of deduction from the primary elements has been followed.

In conclusion it may be remarked, that many objects in nature exhibit colours of a more brilliant and intense nature than any of the examples here given; and that in art also, it is possible by glazing, and other adventitious means, to enhance the brilliancy and intensity of pigments; but no such means of producing an effect is here employed; and every hue, tint, and shade, in these examples, are consequently made to bear their true relations to the six positive colours given in Plate I., being also, for the most part, produced by combinations of the same pigments.

## APPENDIX.



## A P P E N D I X.

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### OBSERVATIONS UPON THE SCIENTIFIC THEORIES OF LIGHT AND COLOUR.

COLOUR is the result of the mutual operation of the active and passive principles of light and darkness; for the action of light being partially interrupted in the production of this phenomenon, every colour is consequently in some degree allied to both—to the latter as well as to the former. Colour is therefore an intermediate phenomenon, the perception of which, like light itself, is conveyed to the mind through the most perfect of our senses, whether in regard to the accuracy and variety of the information it affords, or the pleasure we derive from its exercise. The impression made upon this sense, which conveys to the understanding the perception of light and colour, we receive as we do sound, by means of some inherent quality in the atmosphere; a few observations upon which, and upon the manner in which it is or may be supposed to be acted upon, in the production of colours, shall be here attempted.

Natural philosophers do not appear to have yet arrived at a precise understanding of the nature and properties of light, the consequence of which has been the promulgation of many theories, compounded almost wholly of mere conjecture. But the first theory generally adopted as correct, was the hypothesis that light consists of excessively minute material particles, or molecules, thrown off from the luminous body, whence they emanate with great velocity; diverging in all directions, and always in straight lines. This theory was conceived by Newton, and is called the Newtonian theory. The particles thus thrown off are supposed to be possessed of inertia, and endowed with attractive and repulsive forces, and are emitted from all luminous bodies with nearly the same velocity, about 200,000 miles per second;—that they differ from each other in the intensity of the attractive and repulsive forces which reside in them; and that, impinging on the retina, they stimulate it, and excite vision; producing colour, at the same time, by their different degrees of inertia. It is also supposed that their action upon the molecules of material bodies, and *vice versa*, is that of attraction and repulsion.

Another doctrine maintains, that light is caused by the independent motion of an imaginary fluid called ether, diffused throughout all space, in which waves or undulations are produced by the action of luminous bodies, and propagated in the same manner as sound is, by aerial pulsations. This hypothesis was advanced

by Huygens, and is called the Huygenian theory. The fluid or elastic medium just spoken of, is supposed to be so subtle as to offer no appreciable resistance to the motions of the planets; and is believed to penetrate all bodies, but to possess a different degree of intensity and elasticity in their interior, to that which belongs to it in a disengaged state.

But neither of these theories seems to agree with many ascertained facts in natural philosophy; nor does either of them account in a satisfactory manner for the various phenomena connected with the transmission, reflection, refraction, and velocity of light.

If light be composed of material particles, it is not easy to conceive how they should become weaker as they recede from the luminous body whence they emanated, while their velocity, as is admitted, continues the same; nor is it easy to conceive how they should be reflected in such variety from opaque bodies, and change their character when transmitted through those that are transparent. Besides, material particles, emanating in straight lines from a convex surface, must separate and become more diffused as they recede from it; consequently, light, under such circumstances, instead of becoming gradually weaker, would become necessarily mottled. These, and various other objections, especially that regarding the transmission of light through apparently solid bodies, have been often raised against this theory, but never satisfactorily answered.

Again, to conceive that there is a separate and distinct fluid coexisting with the common atmospheric air, for the purpose of conveying light by undulation, in the same manner as the former is acted upon by vibratory bodies when put in motion, is to conceive a complexity of means greatly at variance with the general simplicity of those by which, so far as they have been investigated, the other wonderful operations of nature are performed. Neither does such a supposition appear consistent with many facts regarding the nature and properties of sound, nor even with those of light, as ascertained by the experimental enquiries of those great men themselves whose names have been mentioned, or of the other eminent philosophers who have followed out their investigations. One of the most celebrated of the latter\* observes, “the fact is, that neither the corpuscular” (the Newtonian theory) “nor the undulatory,” (the Huygenian theory,) “nor any other system which has yet been devised, will furnish that complete and satisfactory explanation of all the phenomena of light which is desirable.”

Under these circumstances, and as little beyond conjecture has yet been advanced regarding the cause of light, or the mode in which it operates in the production of colour, I may perhaps be permitted to hazard an idea of my own upon the subject.

The atmosphere has been ascertained to be an elastic fluid, impenetrable, inert, moveable, and possessed of

\* Sir J. F. W. Herschel.

a certain gravity, reducible in proportion to the degree of attenuation to which it may be subjected. It cannot be annihilated, and in its attenuated state it retains the same proportions in its gaseous elements. The fact has also been ascertained that the atmosphere, when pure, is composed of two gases, with the admixture of a small proportion of aqueous vapour and carbonic acid.\* We know that it is at the same time the common receptacle of all the vapours and exhalations that arise from the earth, and which diffuse themselves gradually through it, and as gradually unite again by the principle of affinity or gravitation. To each of the elements just mentioned as constituting by their combination atmospheric air, a specific use in the economy of the animal and vegetable creation may be assigned, except to the aqueous vapour; the simple fact of whose presence, however, is alone sufficient assurance of its having a purpose to serve, since in the productions of nature there is nothing superfluous. Now, as the atmosphere is admitted to be a body, may we not suppose that it is constituted like other elastic bodies, though it cannot, like those that are solid, be brought within the sphere of microscopical investigation, and that this aqueous vapour is distributed throughout the

\* The proportions of these elements are as follows:—

	By Weight.	By Measure.
Nitrogen Gas,	77.50	75.55
Oxygen Gas,	21.00	23.32
Aqueous Vapour,	1.41	1.03
Carbonic Acid,	0.08	0.10

atomic interstices in the form of an infinitely minute and symmetrically reticulated fibrous tissue, susceptible of tension and attenuation, like that known to exist in animal and vegetable substances ?

By such a supposed distribution of the aqueous vapour, an independent vehicle of sound is at once supplied, and the gaseous elements of the atmosphere left to perform their wonderful and important duties in the economy of the creation, undisturbed. By such a supposition, too, regarding the constitution of the atmosphere, and of liquid and aeriform bodies generally, their various capabilities of condensation and attenuation would perhaps be more easily accounted for; as also the phenomenon in acoustics produced by the attenuation of atmospheric air under the receiver of an air-pump, when it so far loses its vibratory power as to become, in consequence, incapable of conveying sound. The supposition which I have hazarded, will also satisfactorily account for the greater facility with which sound is transmitted in the lower regions of the atmosphere, where the relative proportion of the aqueous vapour to that of the gaseous elements is greater than in its higher regions.

The manner in which smoke and other visible vapours are observed to diffuse themselves through the atmosphere—the phenomenon of snow assuming beautiful hexagonal figures, as well as the extremely elegant appearance and combinations which hoar-frost presents when minutely examined—favour the supposition now

advanced. Because, unless there were in the body of the atmosphere symmetrical reticulation, we should not find in snow-flakes the uniform figures which they present, and which, it is presumed, they could not otherwise acquire than by passing through such a medium.

The gases which enter into the composition of atmospheric air, as well as all other gases, are, according to a well-established theory, composed of atoms or molecules. Now, adopting this theory, may not the sun or any other luminous body possess a power of acting upon the atomic particles of one or both of these gases—electrically or otherwise—in such a manner as to put them into harmonic motion amongst themselves, each upon its own axis, and rendering them luminous by friction, thus producing white light? May not the partial interruption or change in the mode of this atomic motion produce shades and colours, and its total interruption blackness? As every material body is also understood to be composed of atoms or molecules, may it not likewise be reasonably supposed that the modes of arrangement, or the configuration of these atoms, render them capable of receiving this motion of light, in ways infinitely various, producing every variety of colour? May not dyeing be simply the production of a change in the arrangement of the atoms of which the substance dyed is composed, thus affecting the atomic action of light upon its surface? May not the mode of arrangement in the atoms of crystals and other transparent media be thus affected, and made to communicate a like motion to those of

the atmosphere beyond them, producing coloured light; as those atoms on the surface of opaque bodies reflect it?

That light does act in some such manner, seems certain, from a communication made on 20th December 1843, to the Microscopical Society, by Mr Ross, relative to the daguerreotype process first noticed by Mr Solly—"If an ordinary daguerreotype portrait be examined with a power of about 200 linear, the surface in the parts upon which the light has acted, is found to be covered with a series of minute dots or globules arranged in a hexagonal form."\*

It seems an ascertained fact, though by the theories hitherto advanced difficult to be accounted for, that the velocity of the transmission of light is in no way dependent on the strength of the light transmitted, and that the reflected light of the moon travels with equal velocity as the direct light of the sun. But by this supposed atomic motion, the difficulty seems removed; for, whether rapid or slow in itself, it may be communicated with equal velocity, in the same manner that the rotatory motion of a notched wheel, at the end of a series of any conceivable length, would transmit to the wheel at the other end a similar motion almost instantaneously.

All this may be easily supposed to take place independently of any vibration, undulation, or other motion in the fibrous tissue, or even in the gases themselves;

\* *Athenaeum*, No. 844.

for we know that when the atmosphere is in a progressive motion, its vibrations follow the direction of its progress. For instance, when the wind blows strongly from east to west, or *vice versa*, a sound is not transmitted so rapidly or distinctly from south to north as when the wind blows in that direction; while the sun's rays, or those of any other light, are equally direct, and proceed with the same velocity, whatever may be the motion of the body of the atmosphere at the time. It may therefore be supposed, that the motion producing light and colour is imparted to the atoms while following the course of the general body of the atmosphere as they come in contact with those under the direct influence of the luminous body, and that this motion is communicated with the rapidity of electricity, which supposition is not inconsistent with other phenomena in nature.

The hypothesis, that variously coloured rays emanate from the sun; each possessing a different degree of intensity, has given rise to the supposition, that there may possibly be a multitude of rays of each colour moving with various velocities, and only affecting the sense when they have the velocity appropriate to that colour in the eye.\* But the hypothesis of atomic motion here suggested, is independent of any such complicated process; for although the motion it supposes to be communicated by luminous bodies to the gaseous atoms may be various, the progress of

\* *Encyclopædia Britannica.* Article, CHROMATICS.

the communication may be perfectly uniform. This hypothesis may also satisfactorily account for the reduced velocity of light when it enters a denser medium.

We know that motion produces friction, and that friction produces electricity. If light, therefore, be produced by motion amongst the gaseous atoms that enter into the composition of all matter, the mode of its production must resemble that of electricity, which it must consequently resemble also in its nature.

It is known that electricity is generated in the atmosphere, in greatest quantities, at that particular season of the year when the sun exercises the greatest influence on it—may not this atomic friction be the cause? Friction produces heat, heat ignition, and ignition produces light. If the rays of the sun be concentrated, such concentration produces the effect of friction in causing ignition; and when ignition is communicated from one body to another, rapid motion of the air which surrounds the body accompanies its decomposition.

Goethe, in his admirable “Theory of Colours,” says, “In examining every appearance of nature, but especially in examining an important and striking one, we should not remain in one spot, we should not confine ourselves to the insulated fact, nor dwell on it exclusively, but look round through all nature to see where something similar, something that has affinity to it, appears; for it is only by combining analogies that we gradually arrive

at a whole which speaks for itself, and requires no further explanation." Such an analogy is found between sound and light, and is in no way at variance with the idea of light being the result of an independent motion of the gaseous molecules in the atmosphere. It is an established fact, that sound is the result of vibratory motions or undulations produced in the atmosphere, similar to the undulations of water into which a stone or other substance has been thrown, with this difference, that in the one case they are apparently superficial, in the other known to be spherical, diverging equally on all sides, perpendicularly and laterally. The effects of this motion in the atmosphere is far from being uniform: sound is undoubtedly the result, but this result is produced in various degrees of modification as to pitch and tone, and these degrees have been ascertained to be communicated through the atmosphere with equal velocity. It has also been ascertained, that a musical note produced by this pulsatory motion in the atmosphere, is invariably accompanied by other sounds called harmonies, in a manner quite perceptible to a fine ear; and that this accompaniment bears the same mathematical relation to the original note that the three primary elements of colour bear to each of their constituents.

Sir David Brewster has shown, that no refracting power is capable of perfectly separating the three colours now universally acknowledged to be the primary elements of chromatics; for however bright they

may be made to appear in the solar spectrum, they still have individually an admixture of one of the other two. We are thus made aware that not only do the elements of sound agree in number with those of colour, but in their affinities; and I have elsewhere endeavoured to show that they also have, in their effects upon the senses to which they are respectively addressed, the most perfect analogy.\*

The more we investigate the operations of nature, the more we become convinced of the simplicity of the means by which the phenomena that are daily attracting our attention are performed. If, therefore, we can account for the phenomena of light and colour as satisfactorily by the means known to exist, as by supposing the necessity of material particles, or an ethereal fluid, to assist these, the subject is simplified, and so far agrees with the facts which philosophy has brought within the sphere of our knowledge.

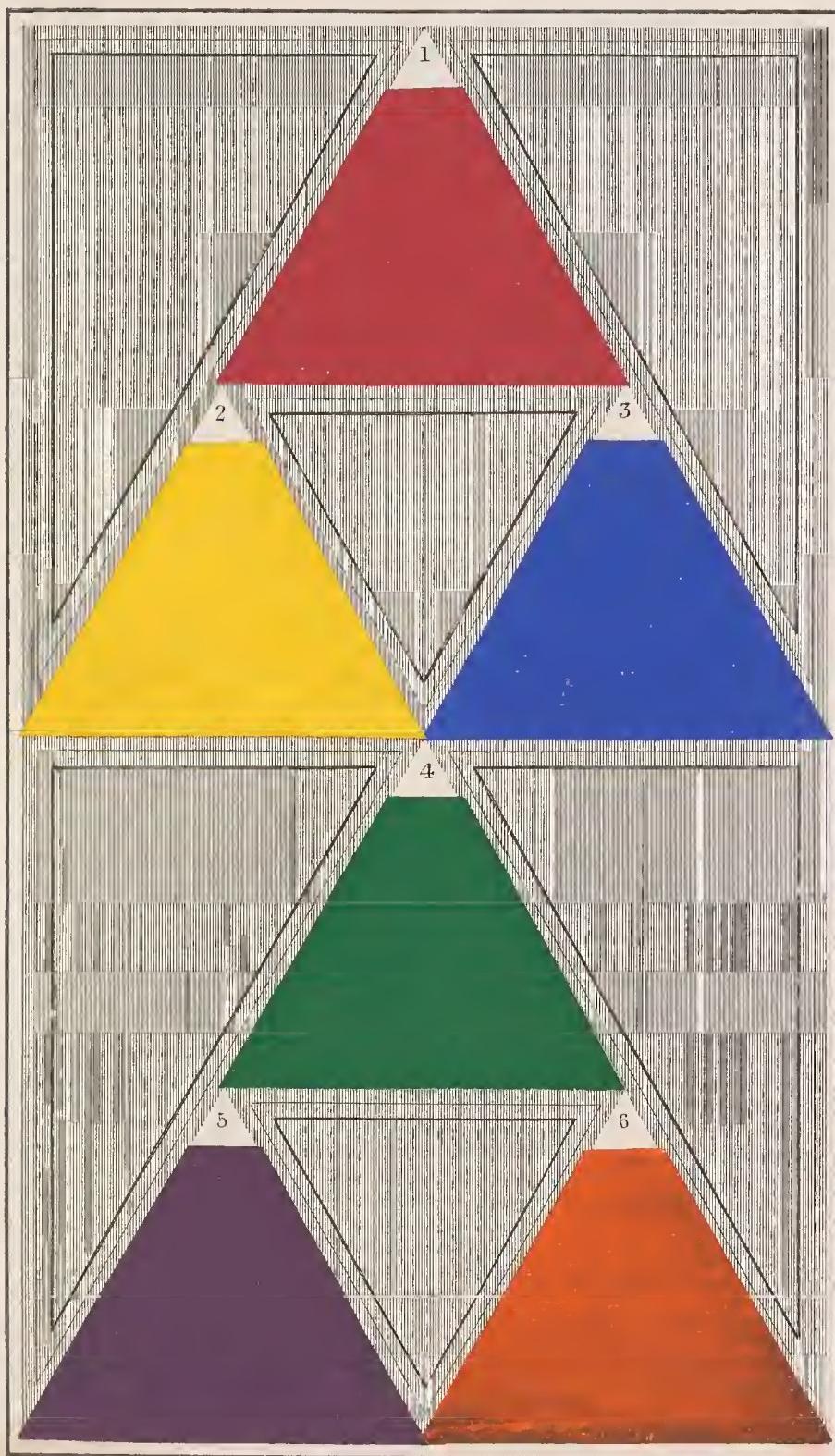
I, however, offer these observations with much diffidence; and should they have no other effect than that of keeping alive a spirit of enquiry into the cause of this, one of the most interesting of the phenomena of nature, they will have served, it may be presumed, no unimportant purpose.

\* Essays on *Form, Proportion, and Colour*.





PLATE 1.



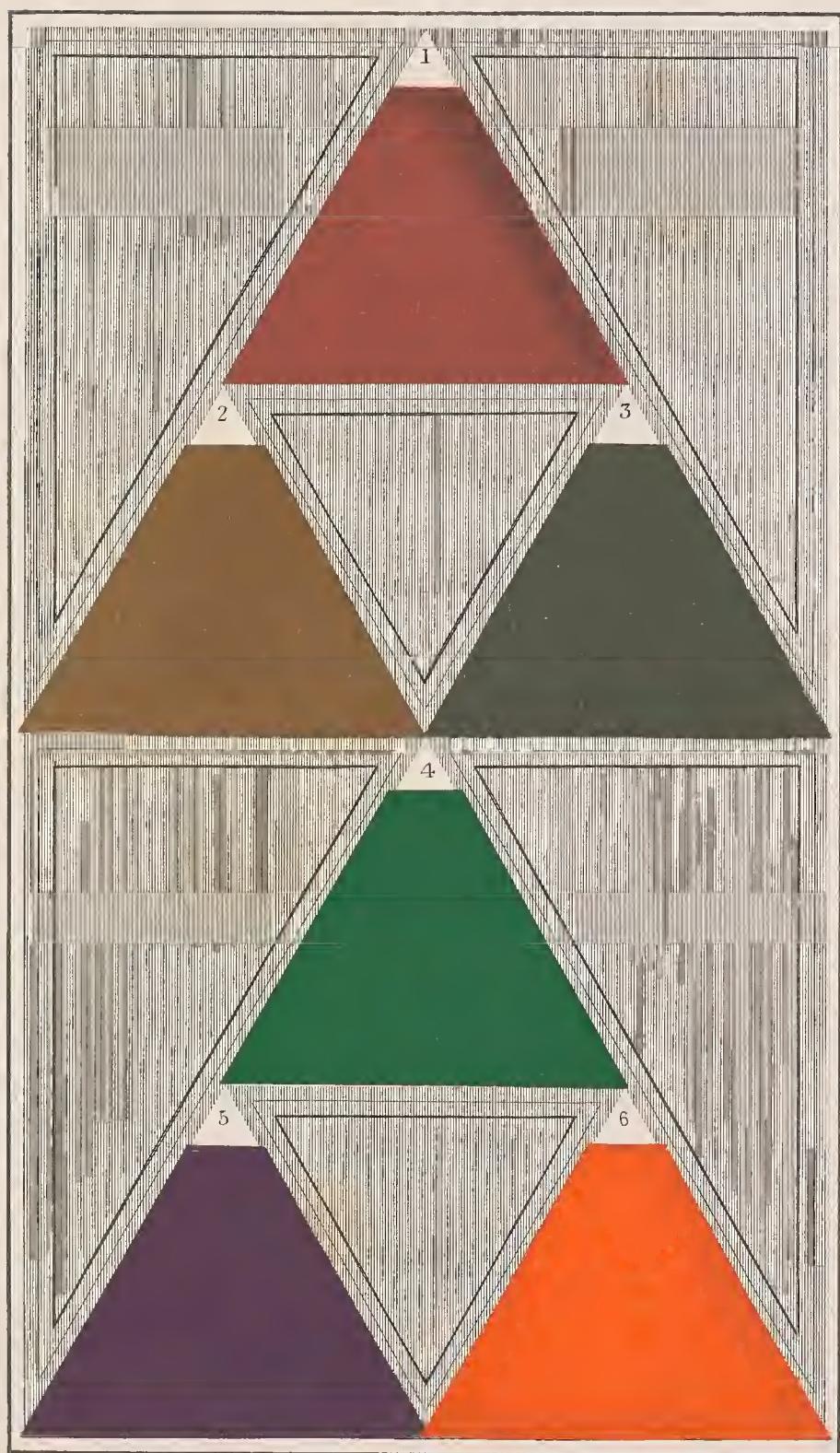
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PLATE 2.



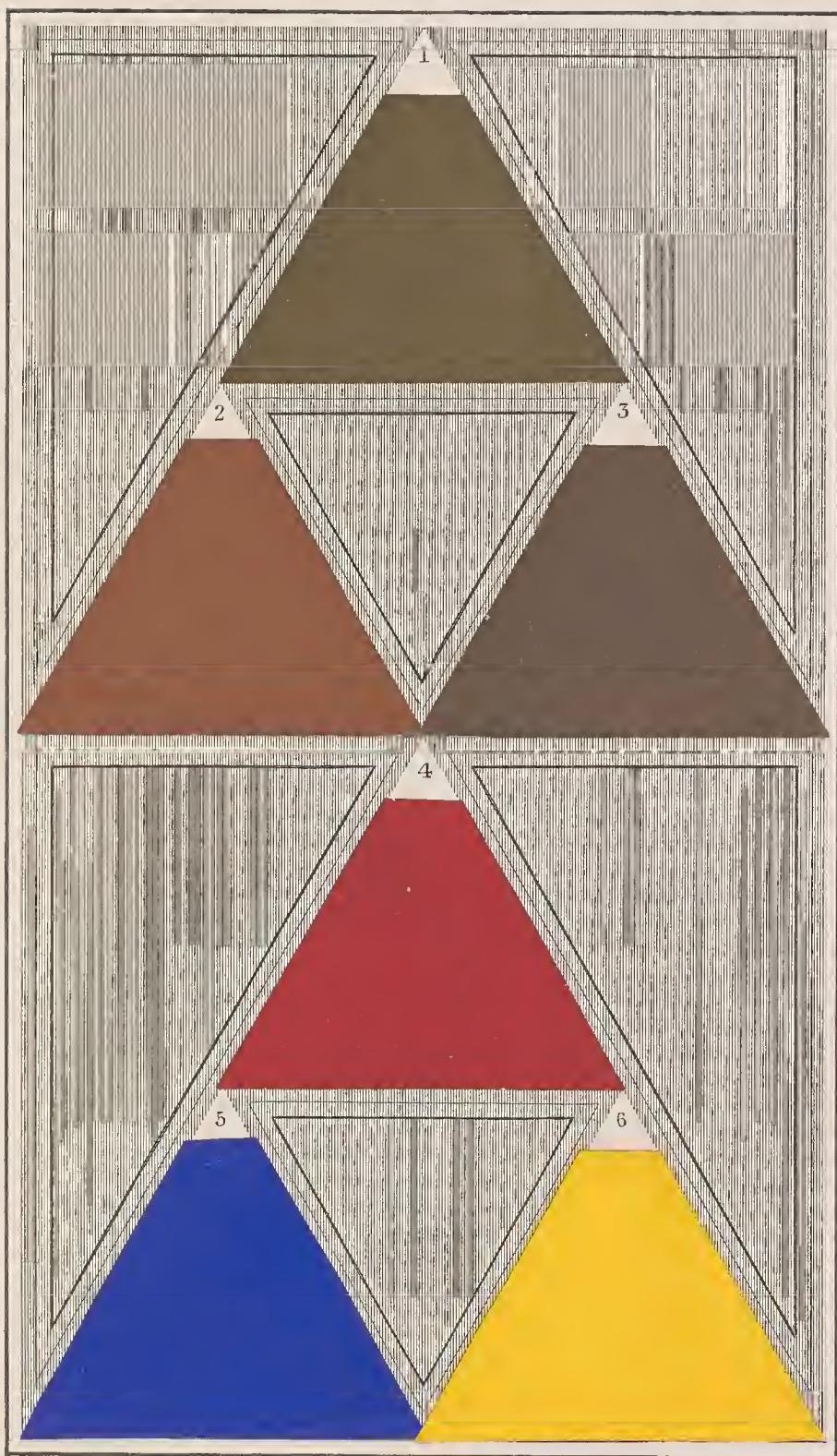
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PLATE 3.



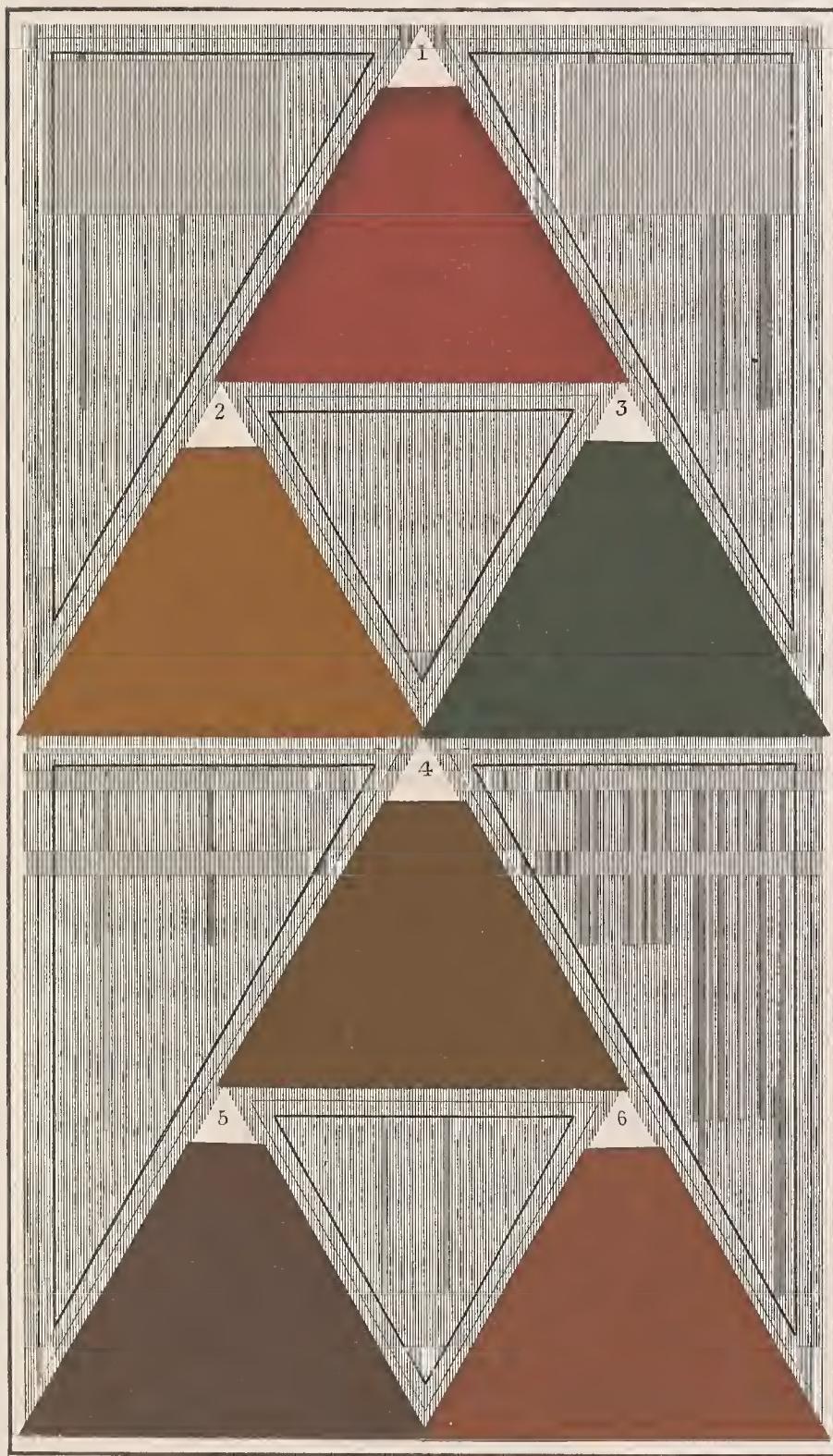
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PLATE 4.



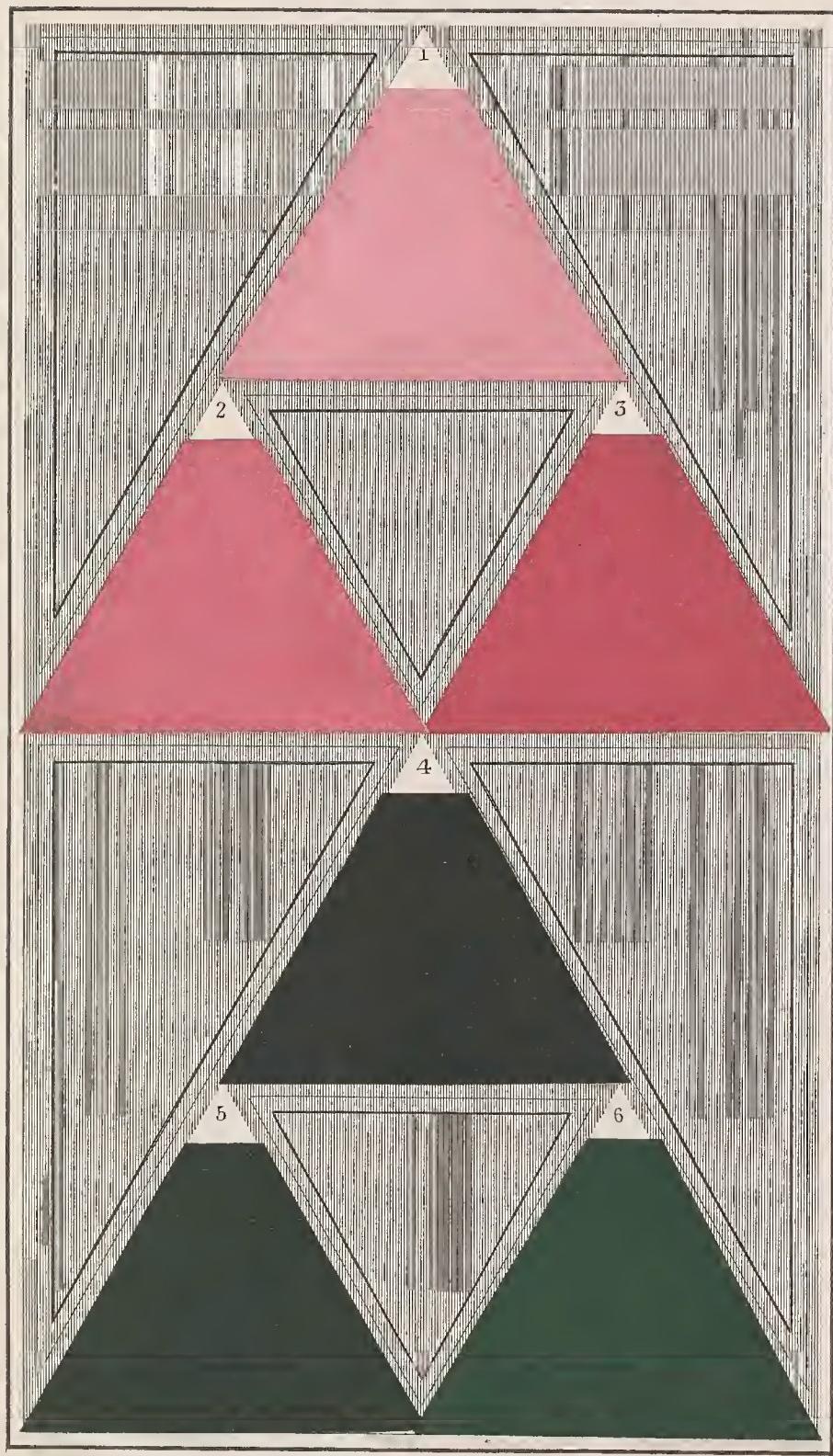
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PLATE 5.



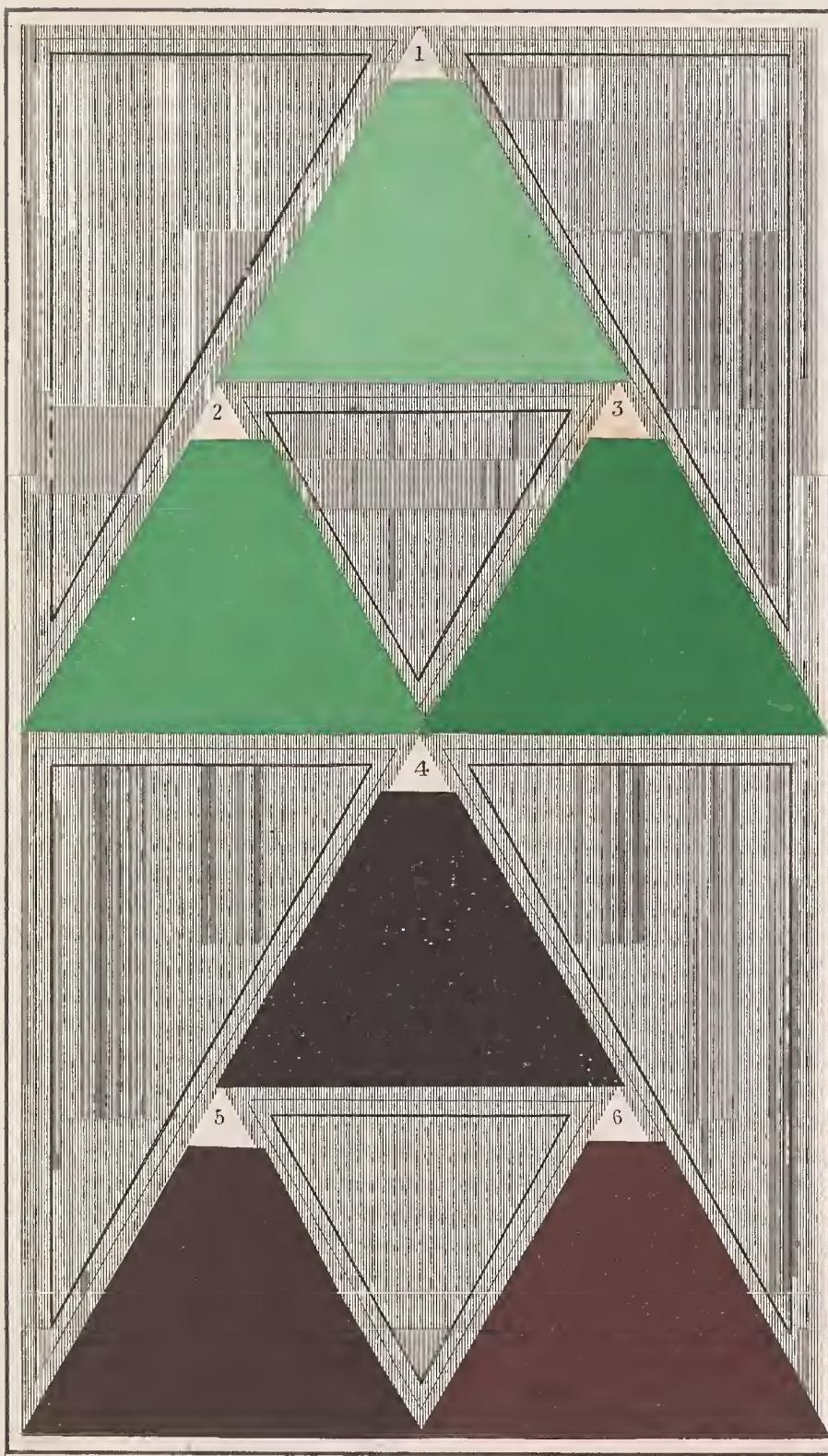
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PLATE 6.



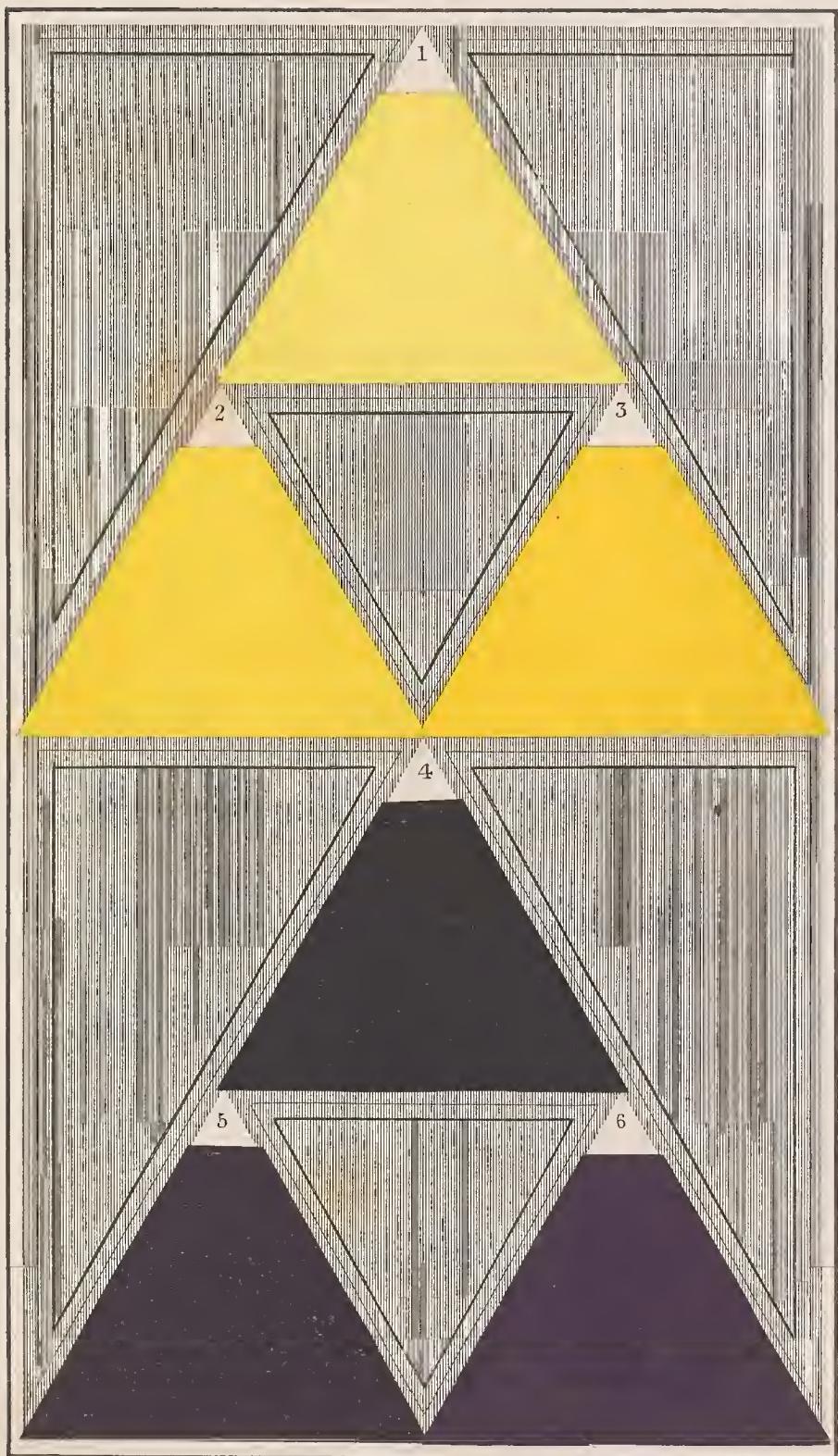
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PLATE 7.



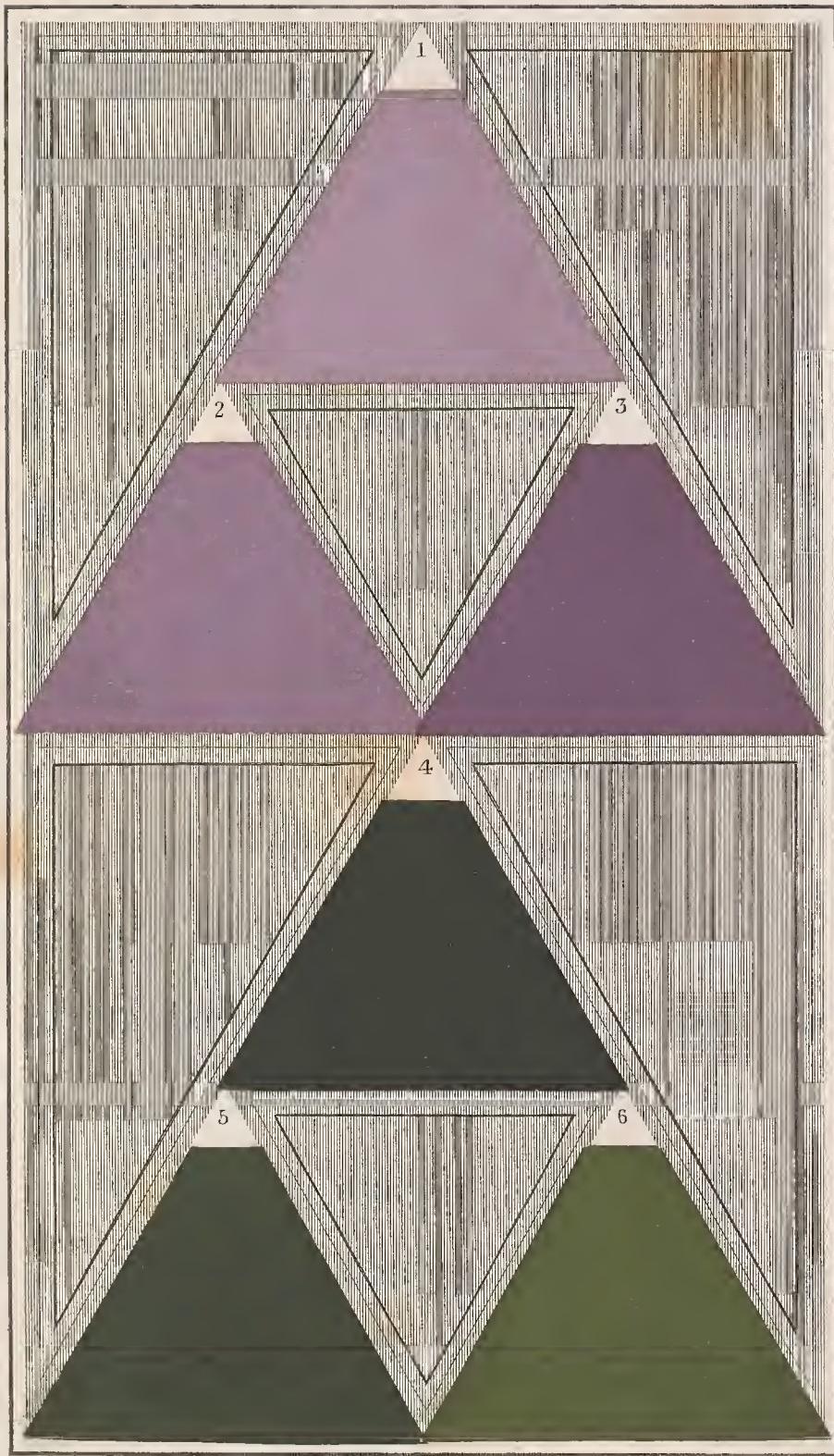
*Lizar & Co.*







PLATE 8.



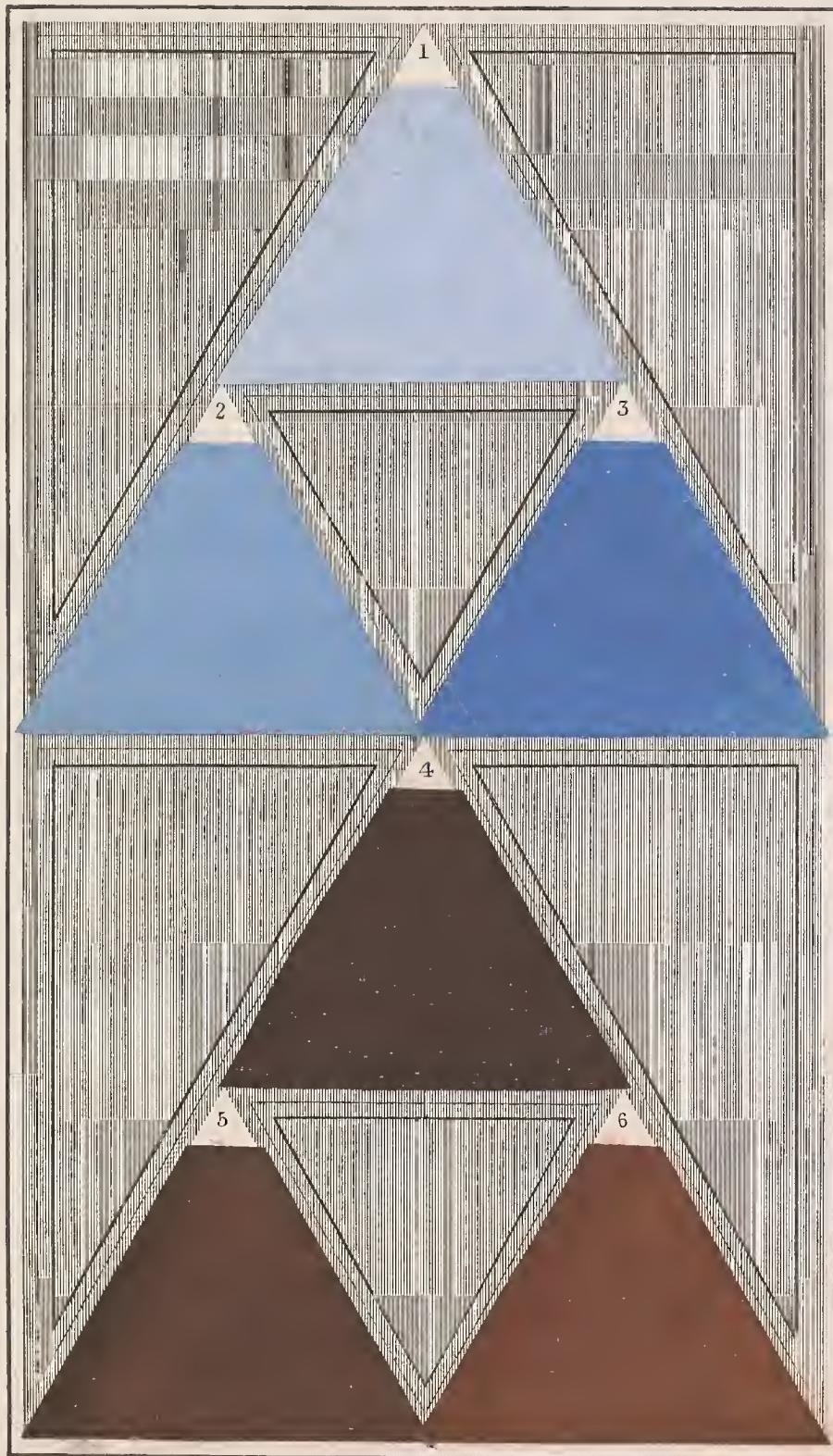
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PLATE 9.



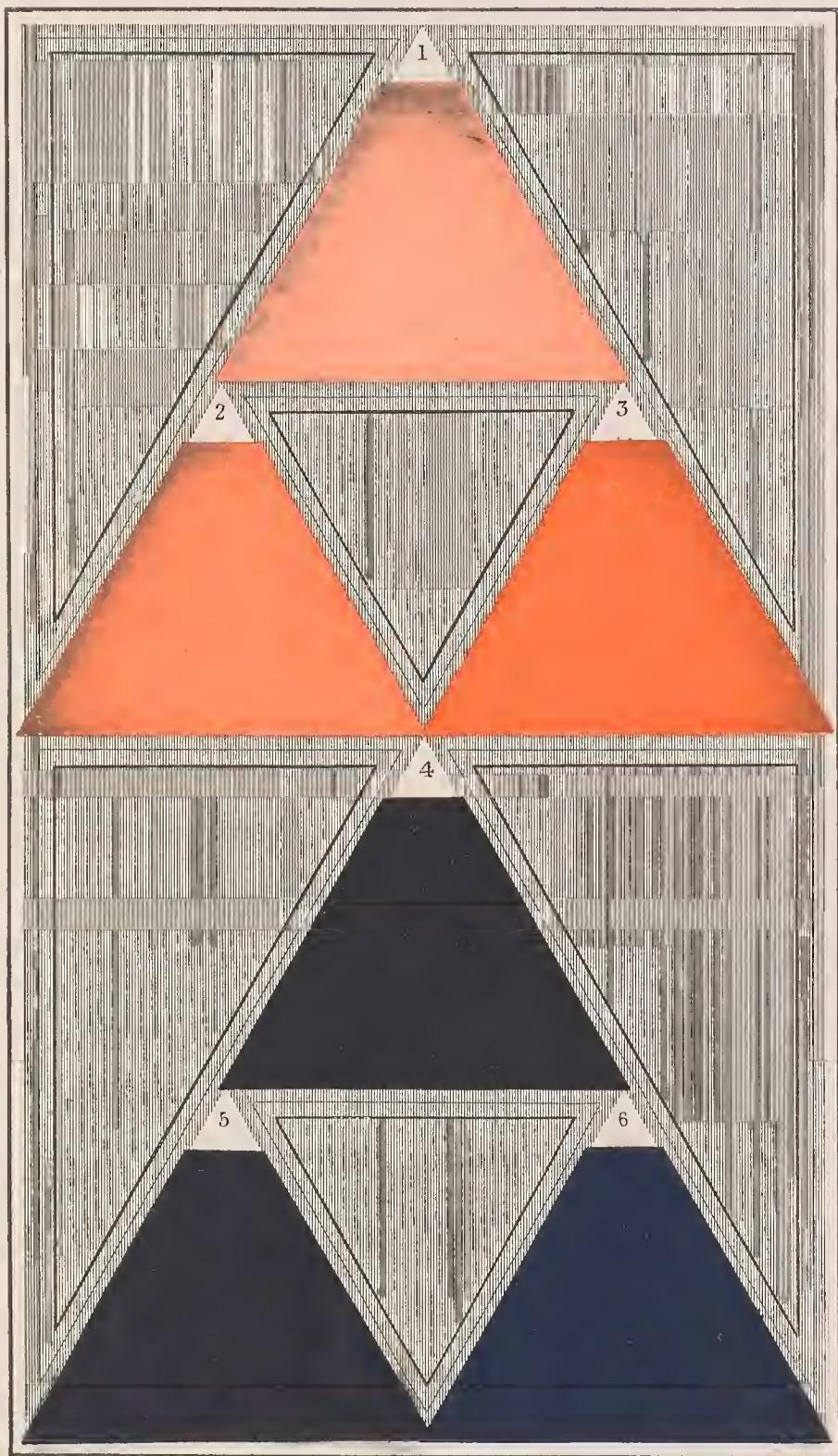
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PLATE 10.



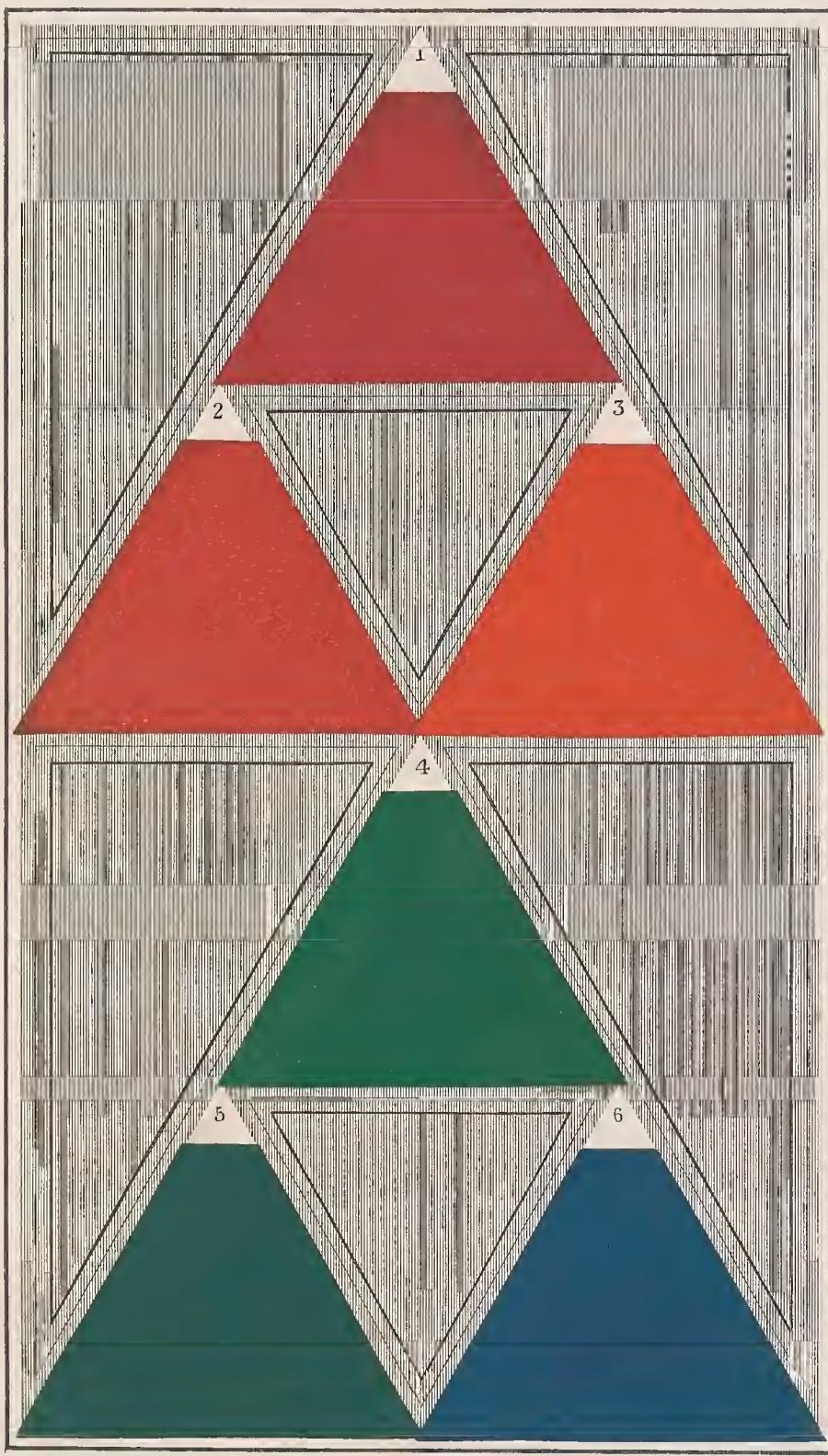
Lizars &c







PLATE 11.



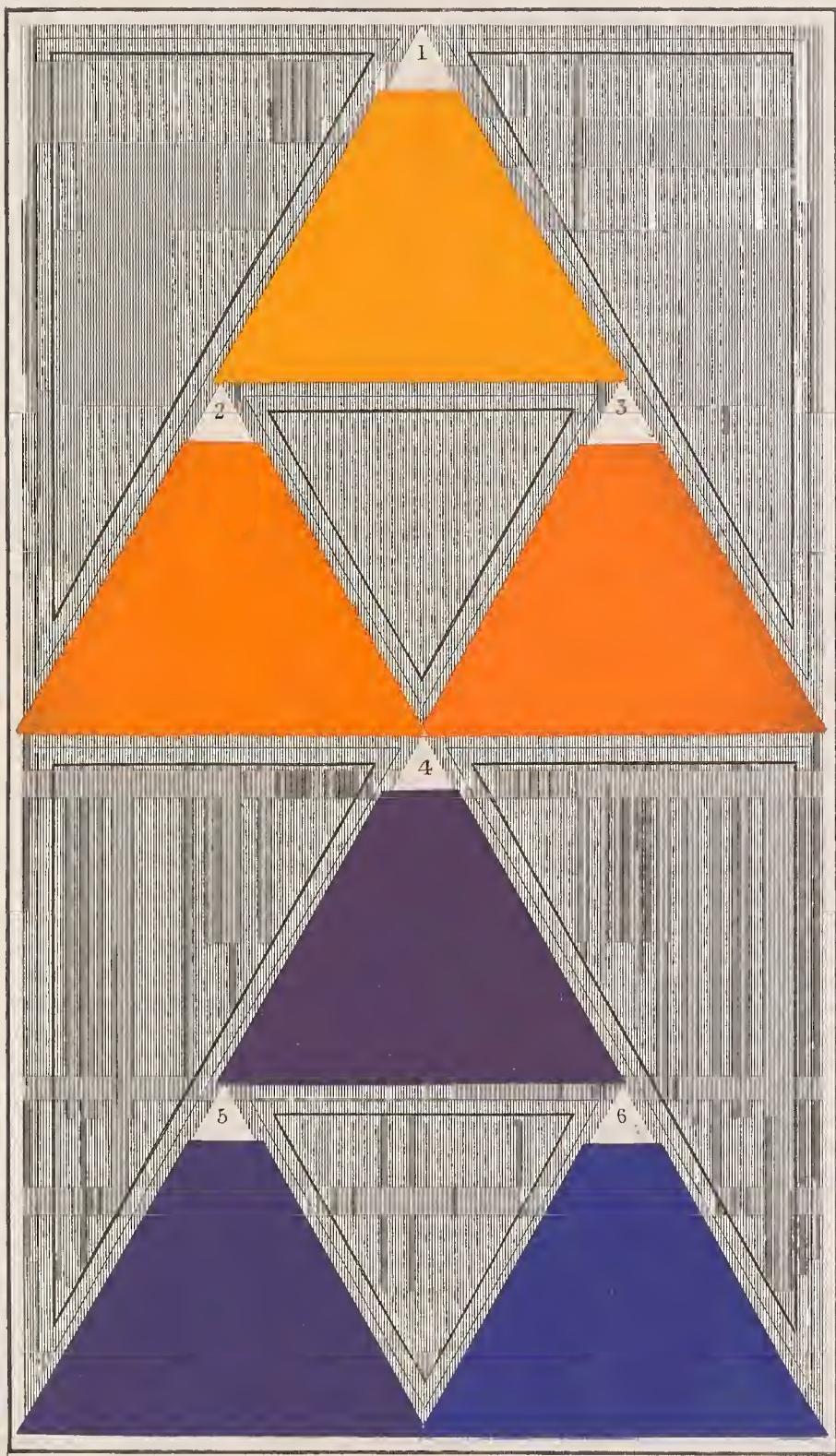
Lizars sc.







PLATE 12.



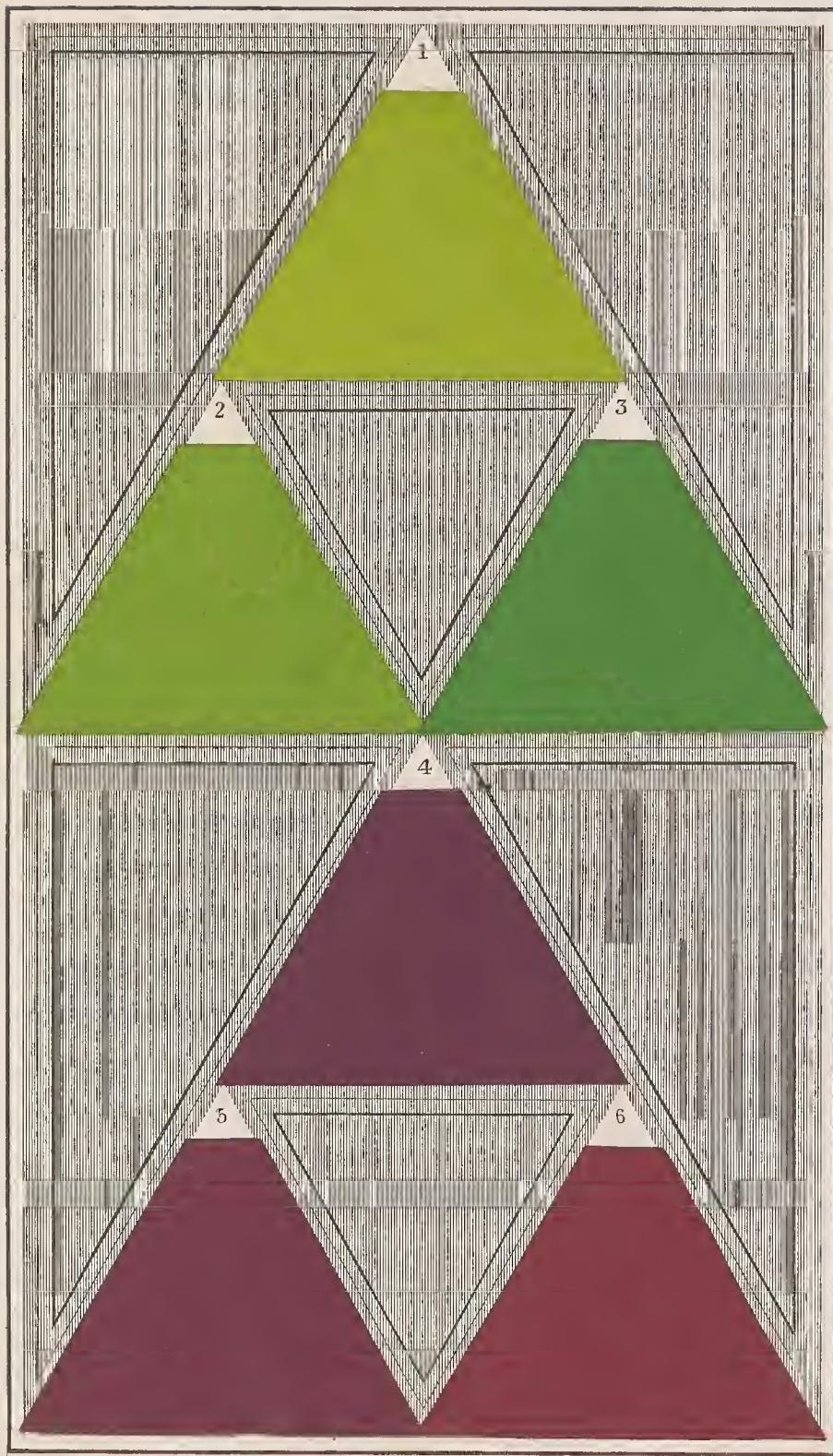
*Lizars sc.*







PLATE 13.



*Litzars sc*





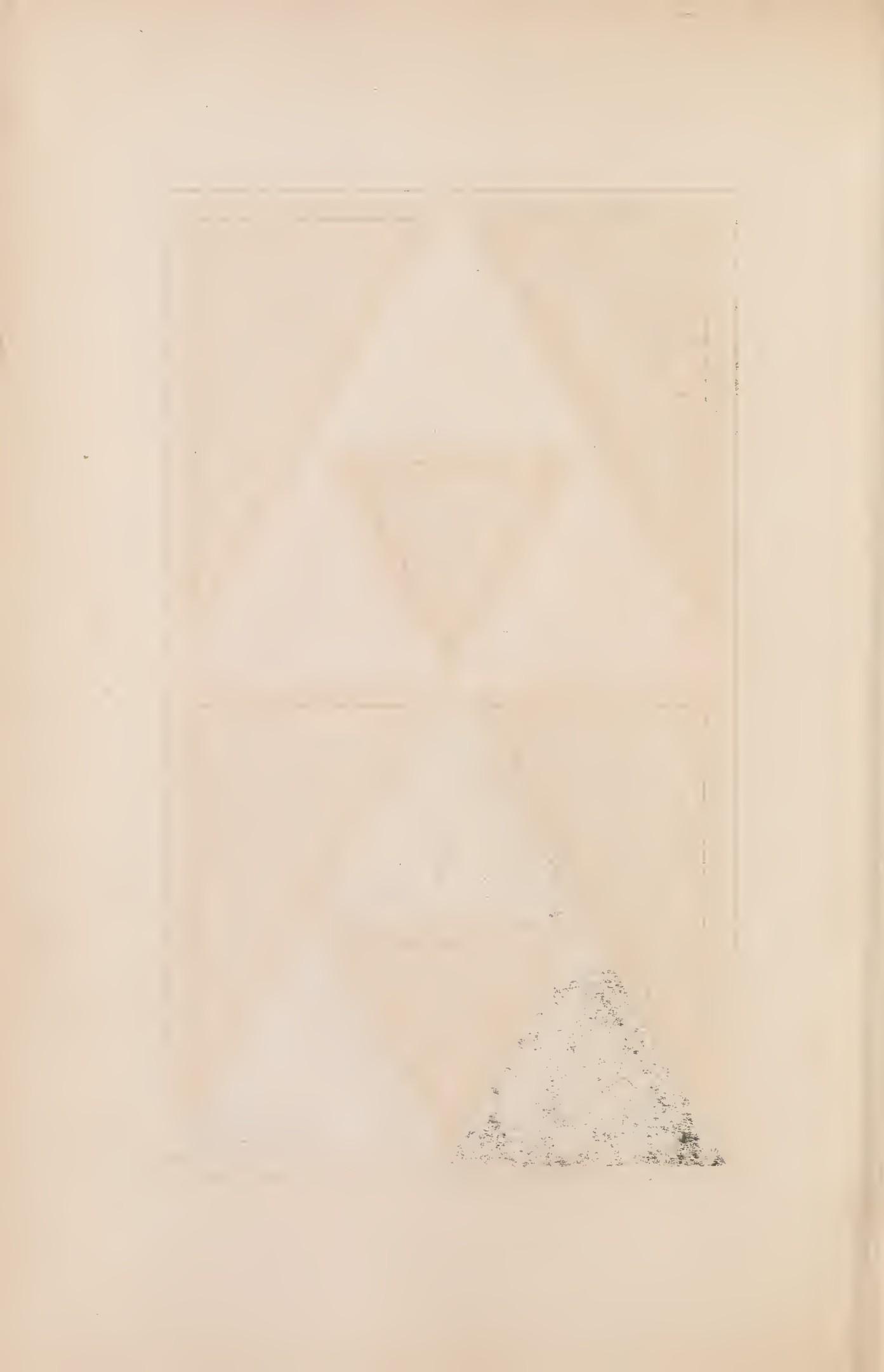
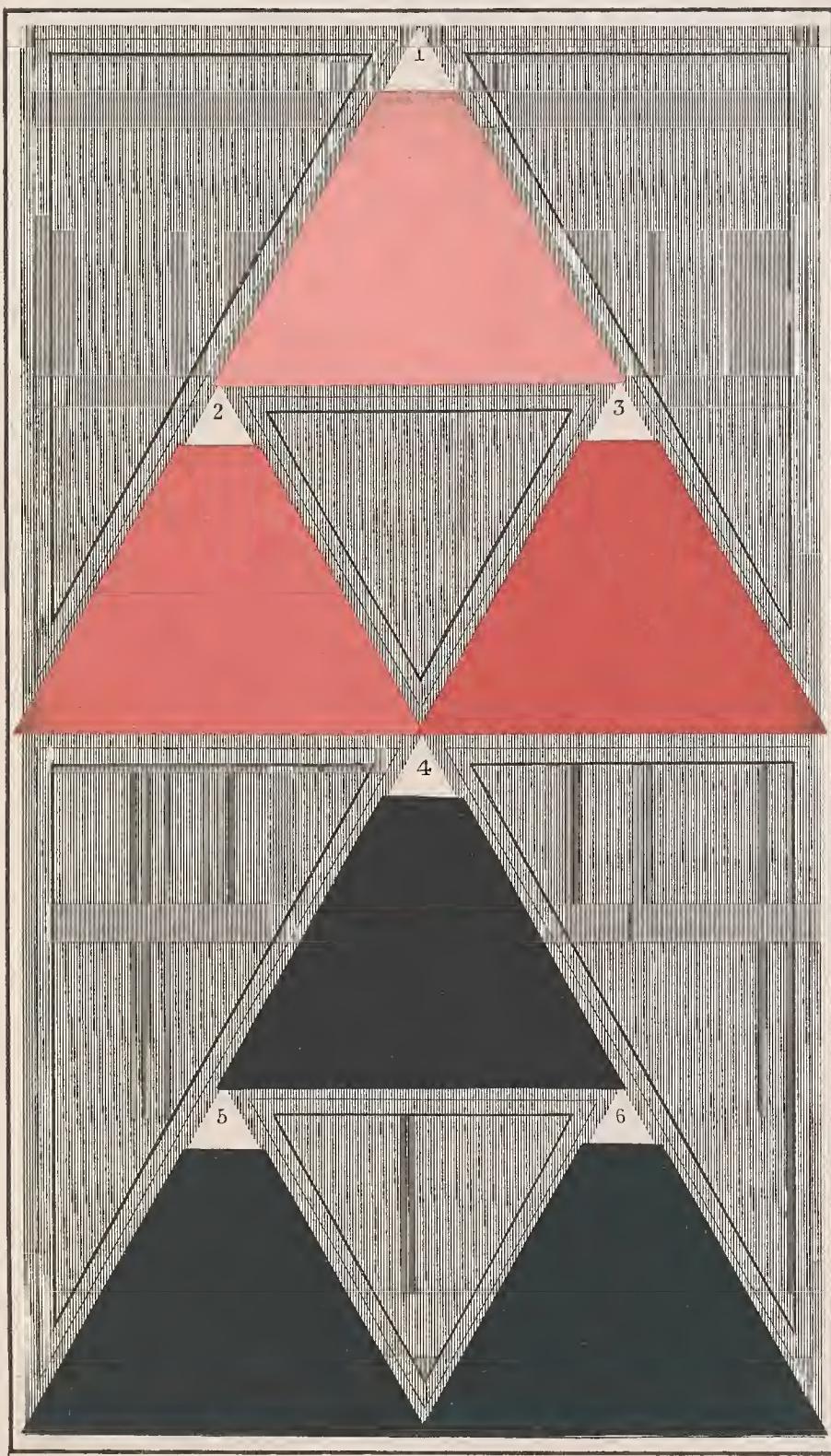


PLATE 14.



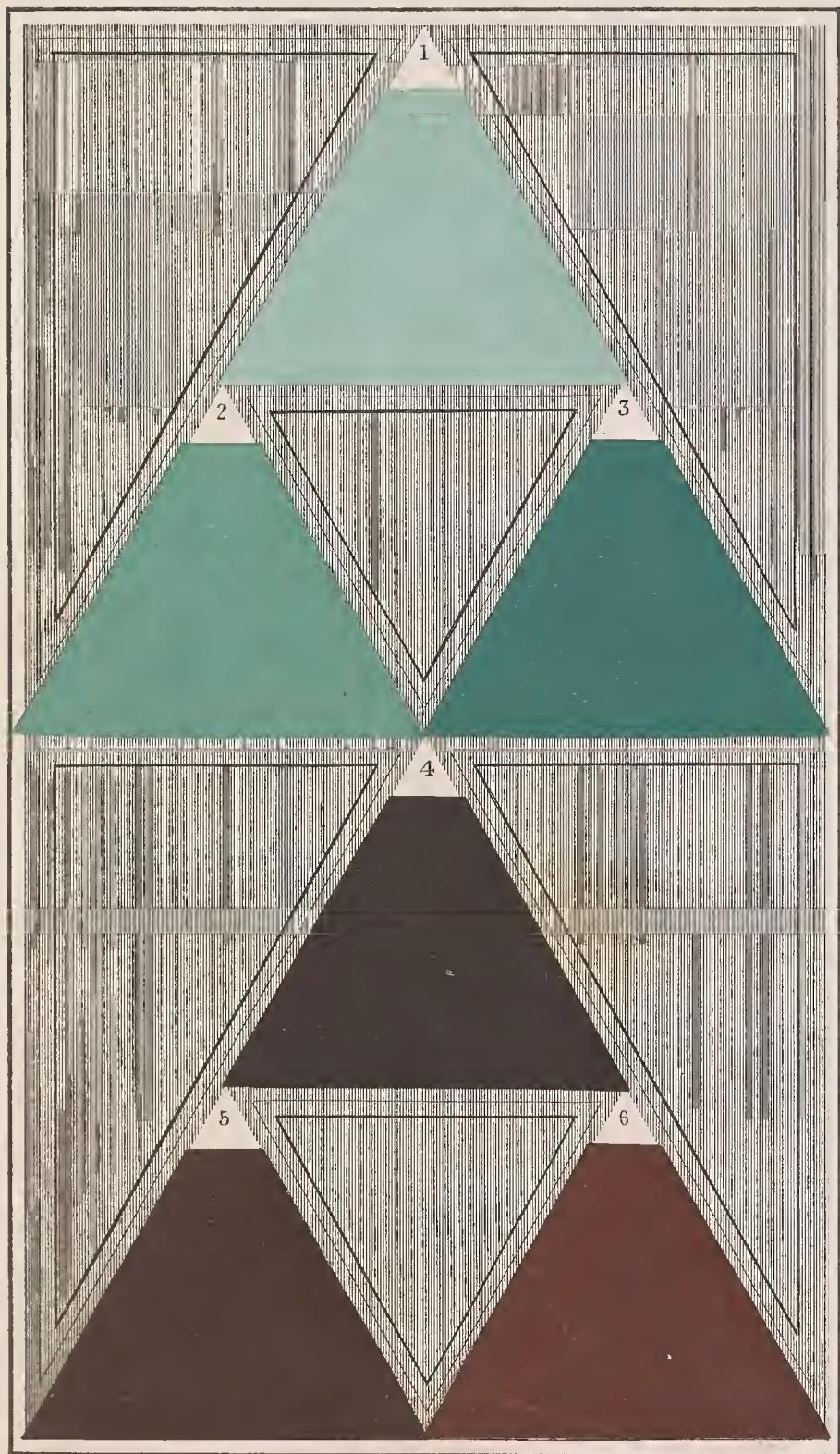
Lizars sc







PLATE 15.



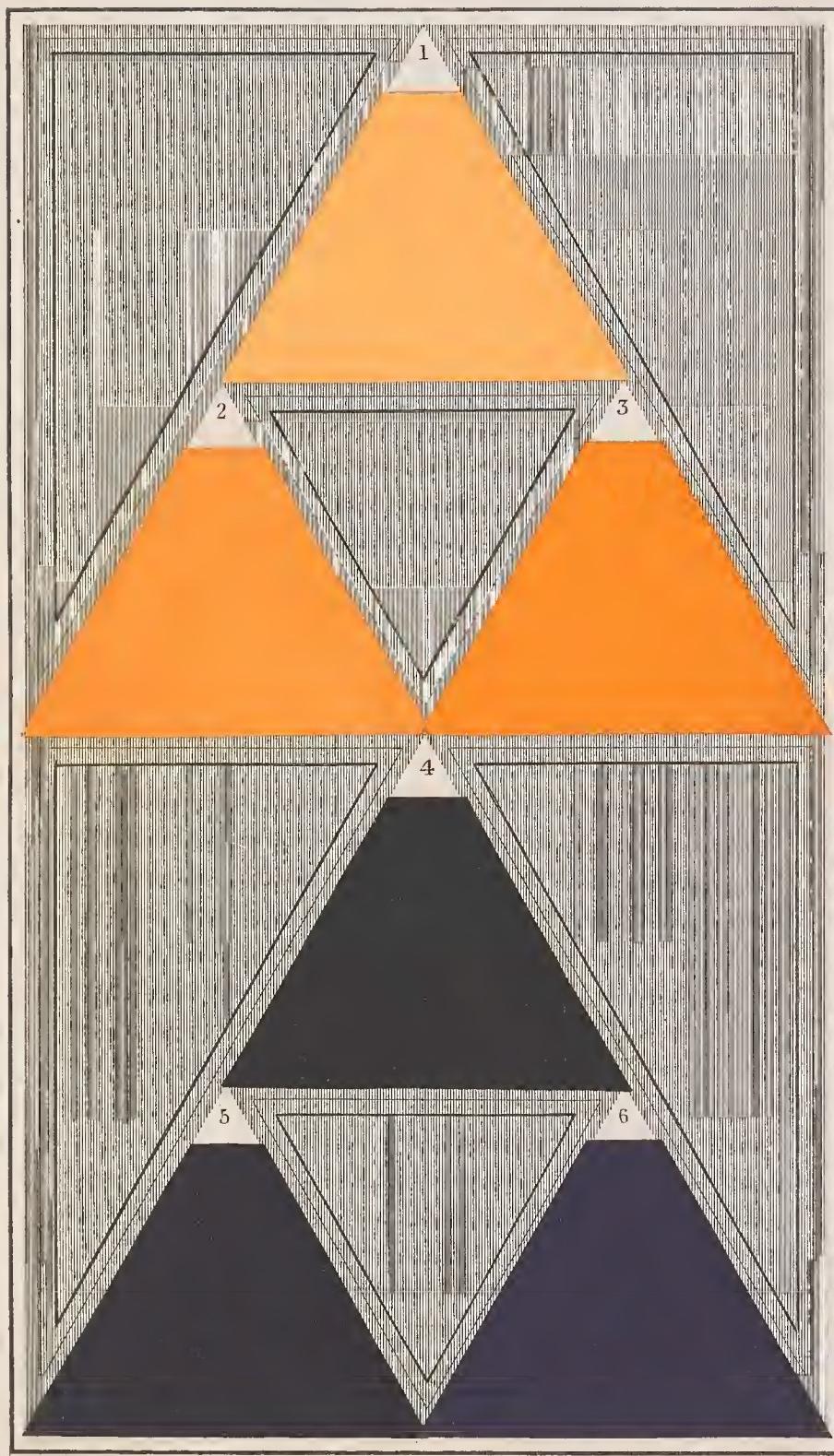
*Lizars sc.*







PLATE 16.



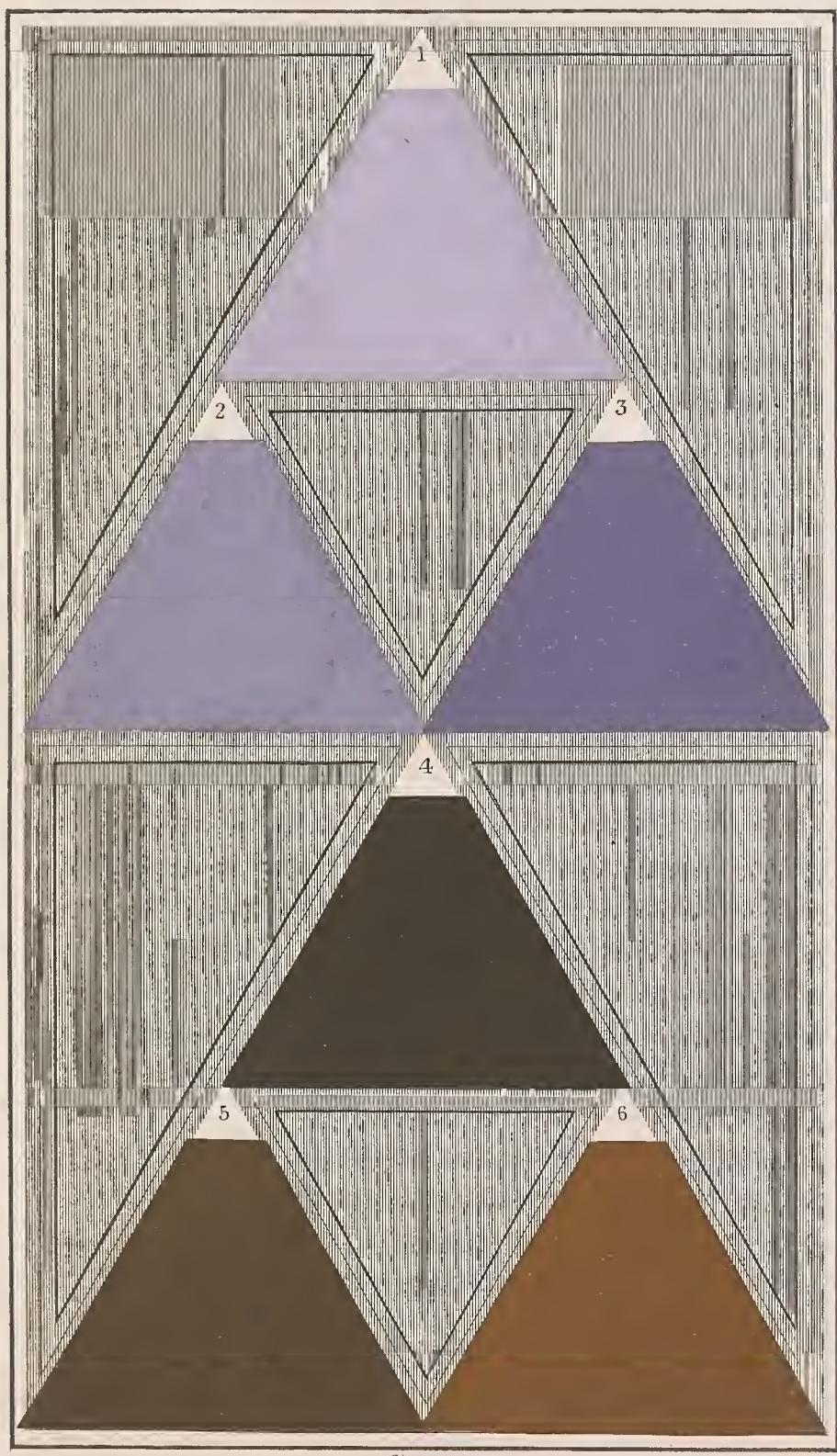
Lizars sc̄pt







PLATE 17.



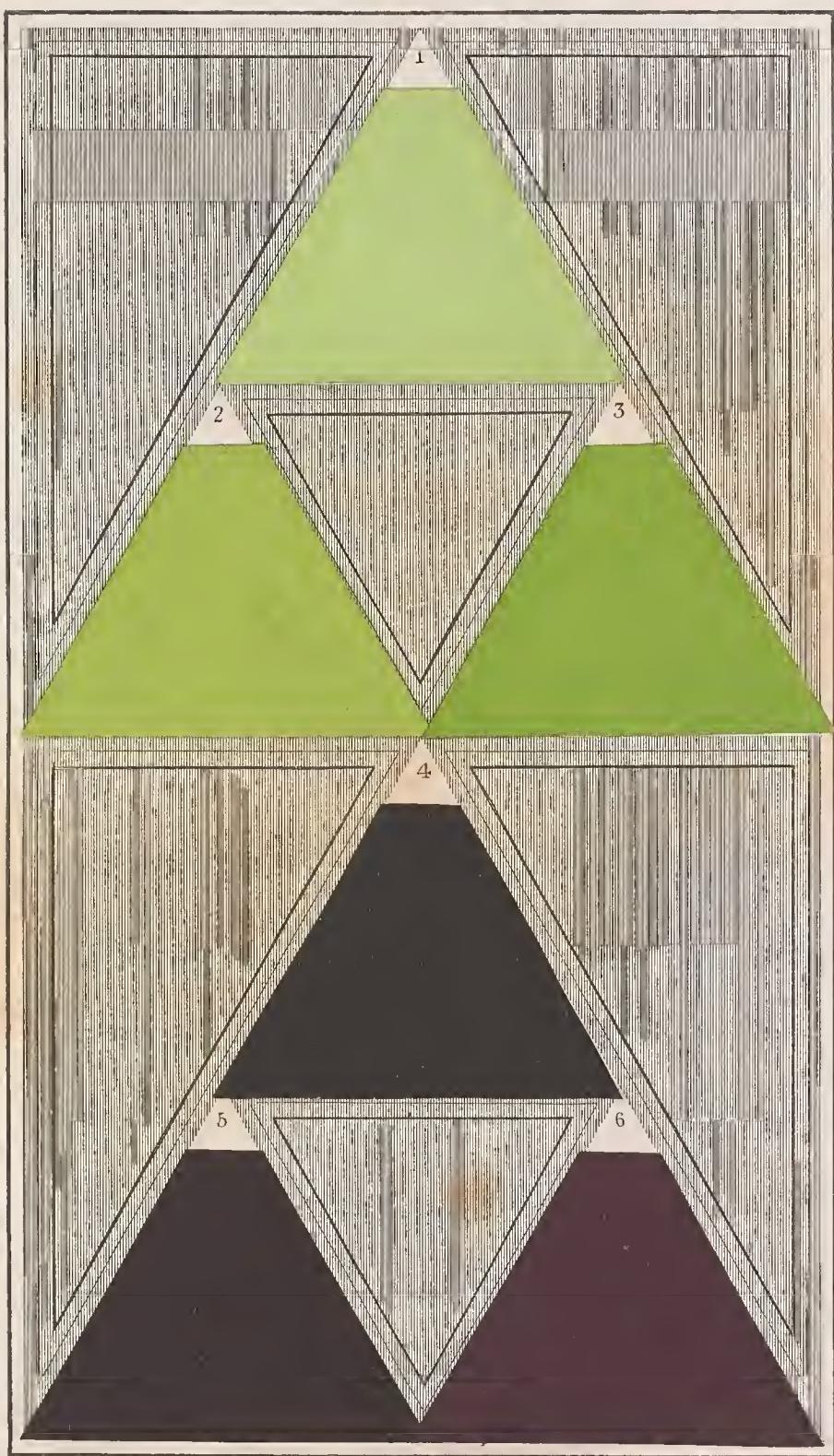
*Lizars sc.*







PLATE 18.



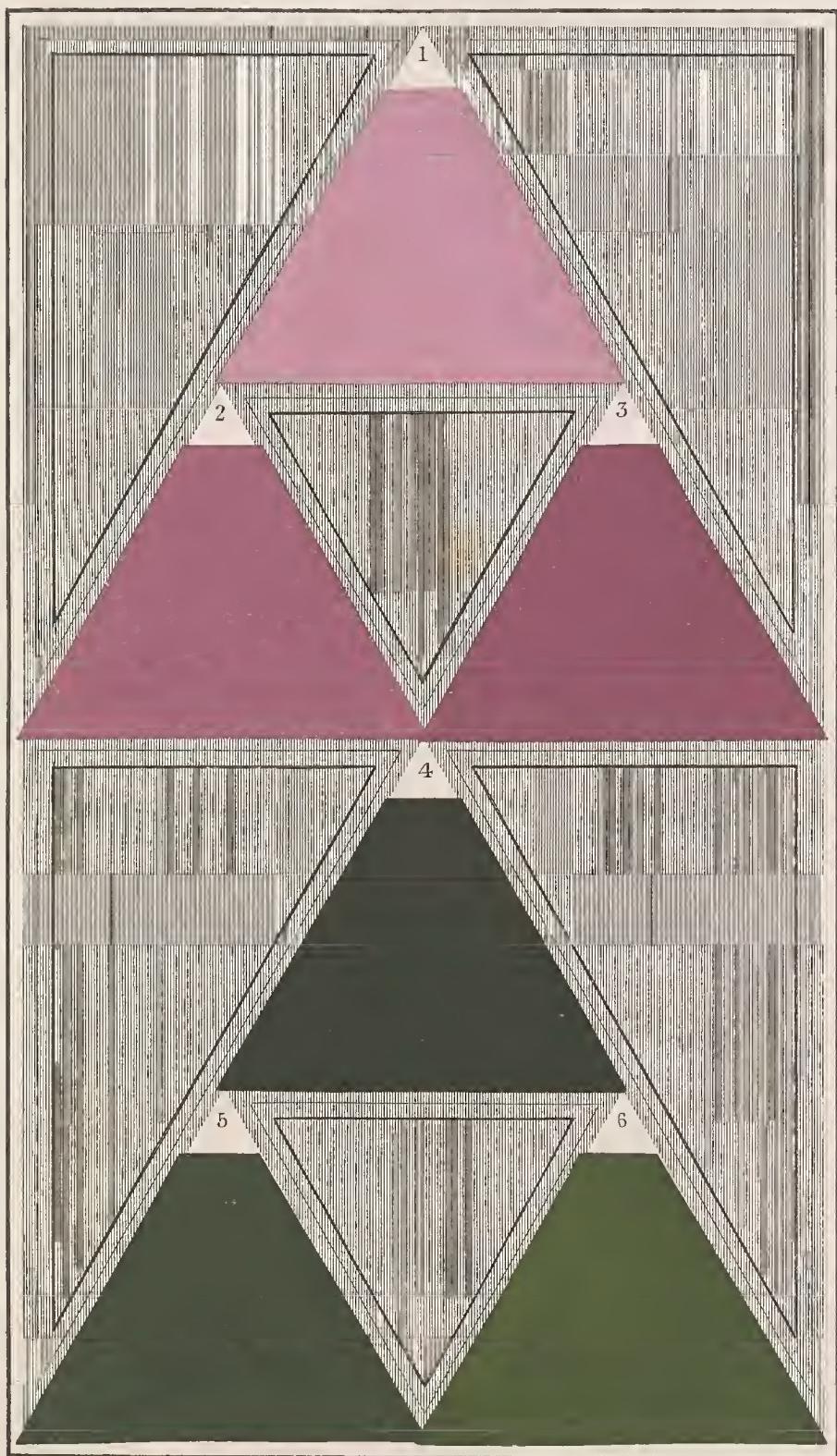
Lizards sc







PLATE 19.



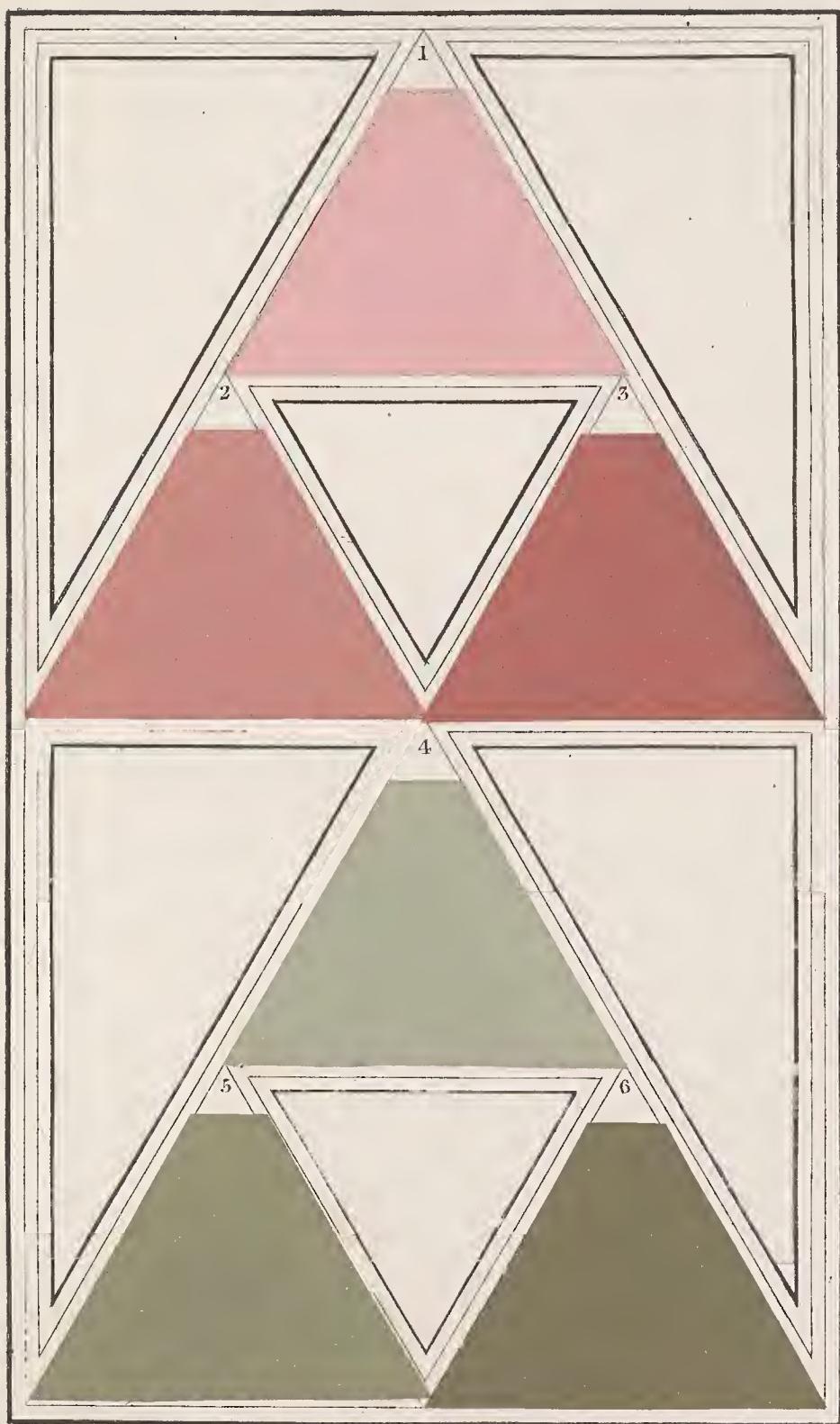
*Lizars sc.*







PLATE 20.



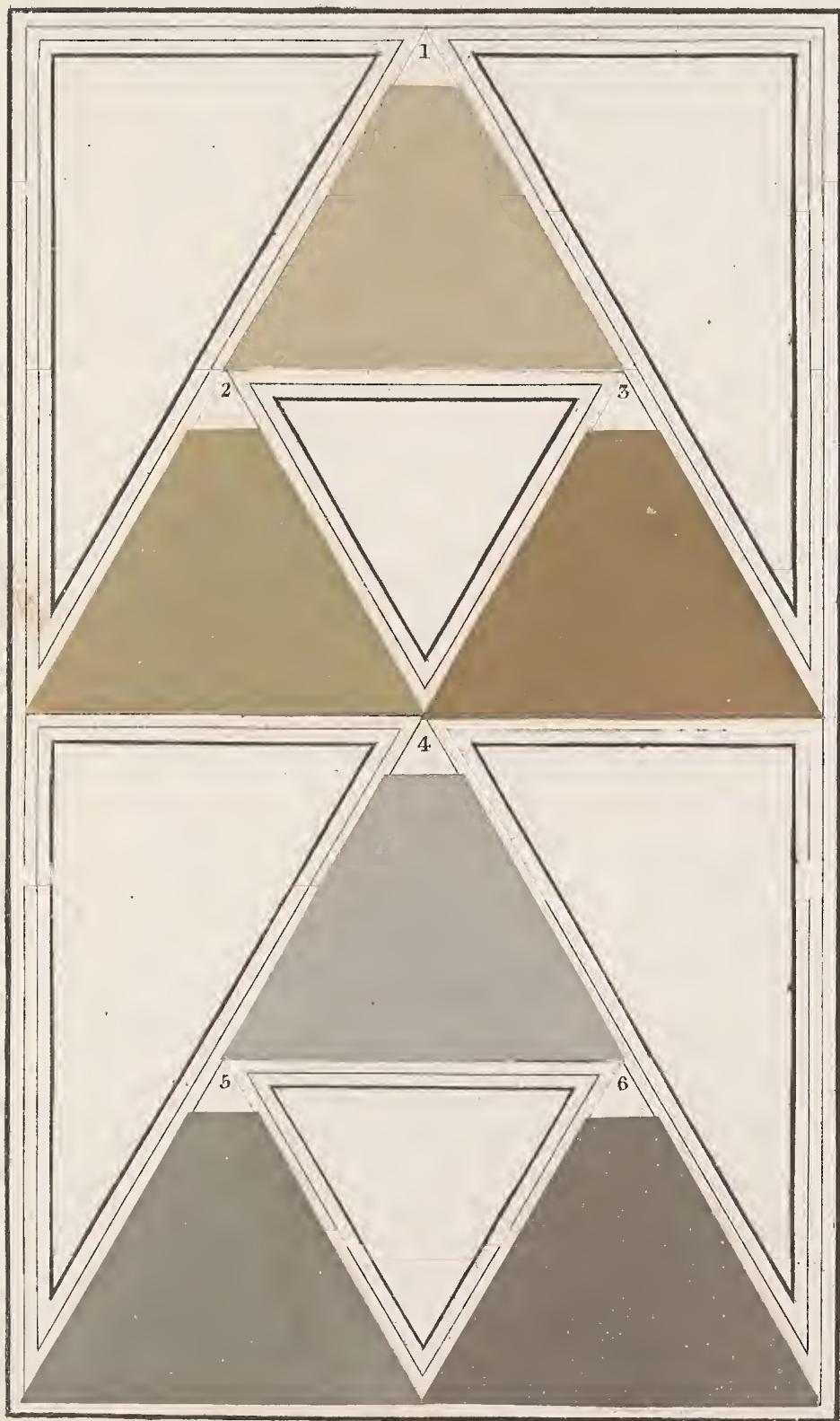
*Lizars sc.*







PLATE 21.



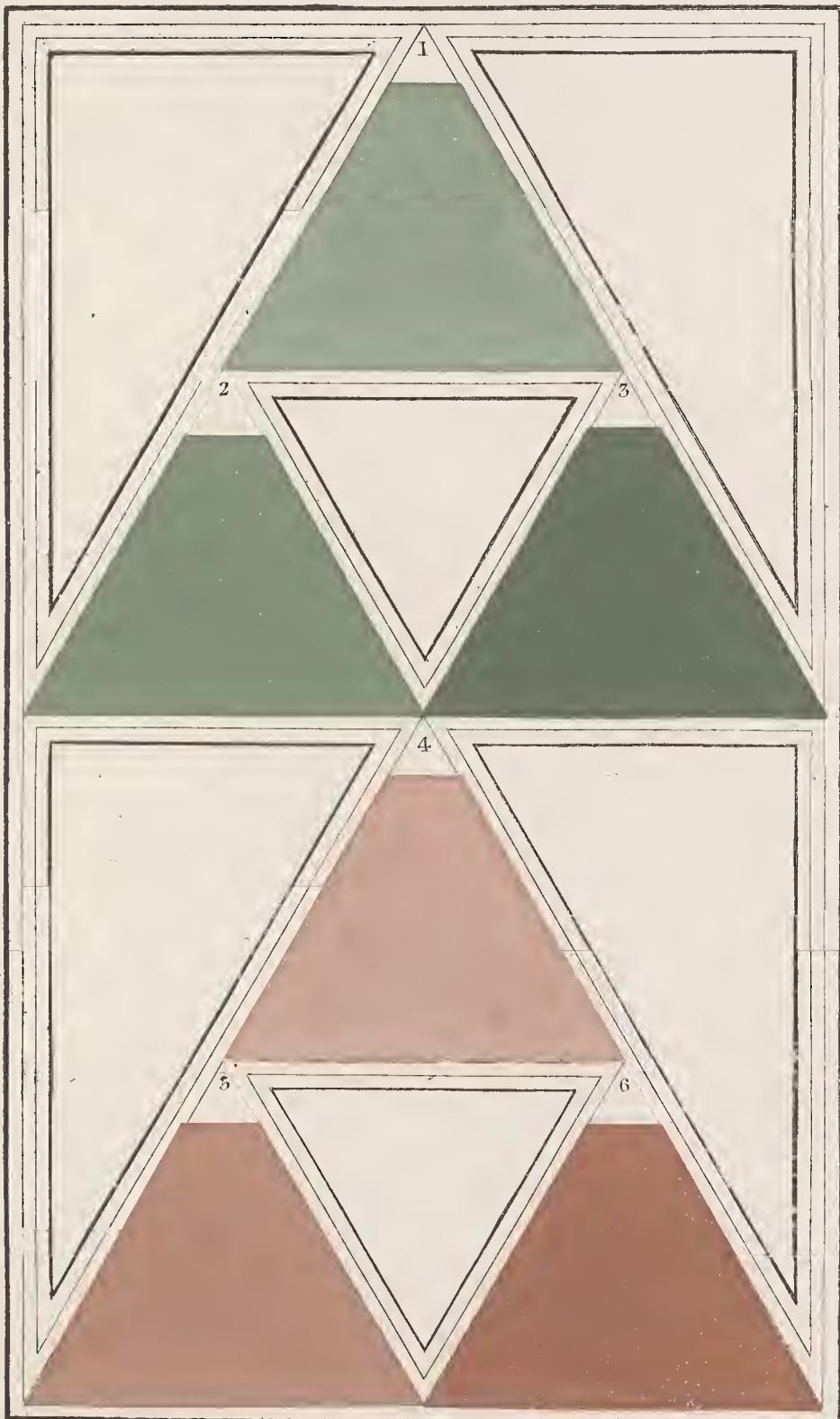
*Lizars sc.*







PLATE 22.



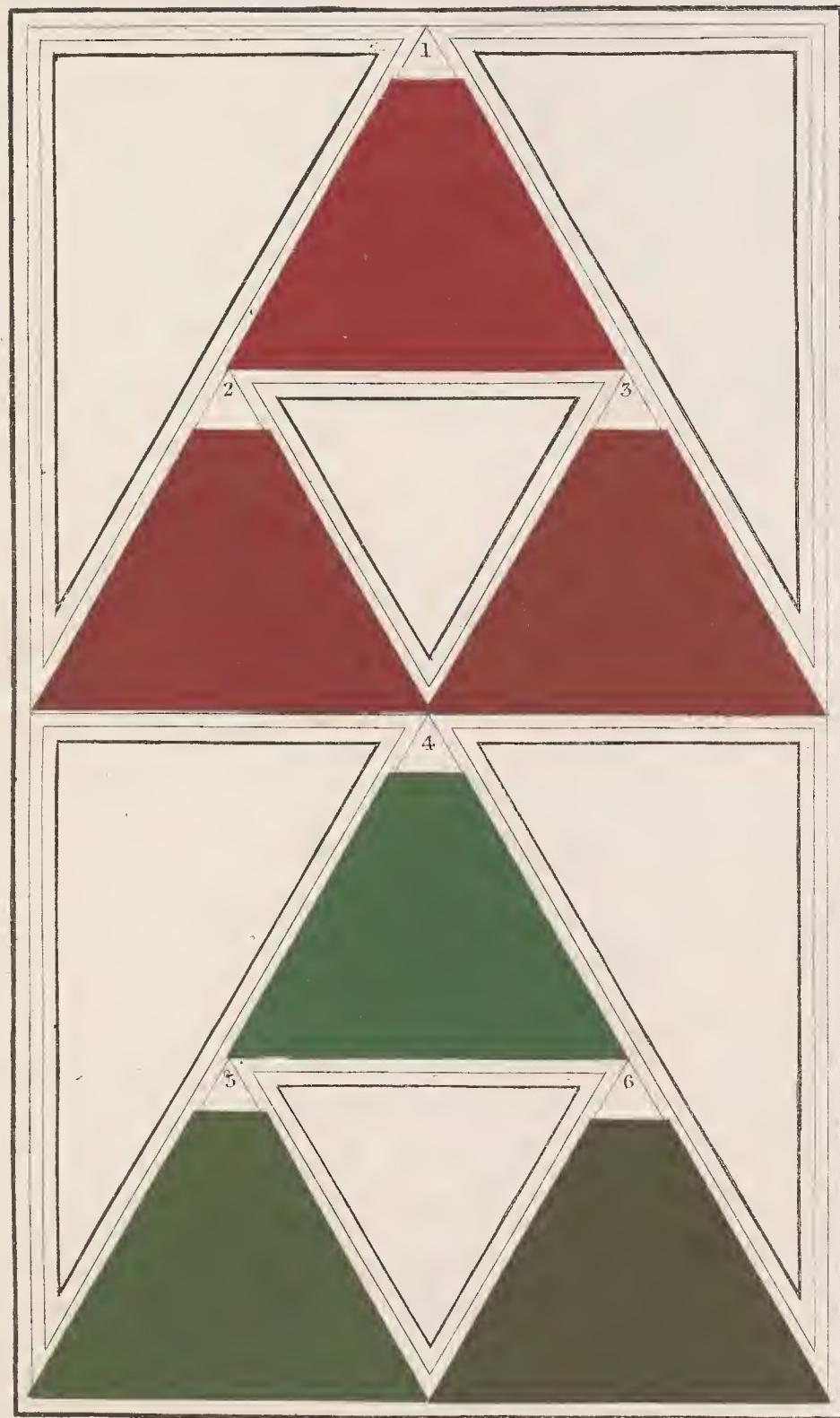
*Lizars sc.*







PLATE 23.



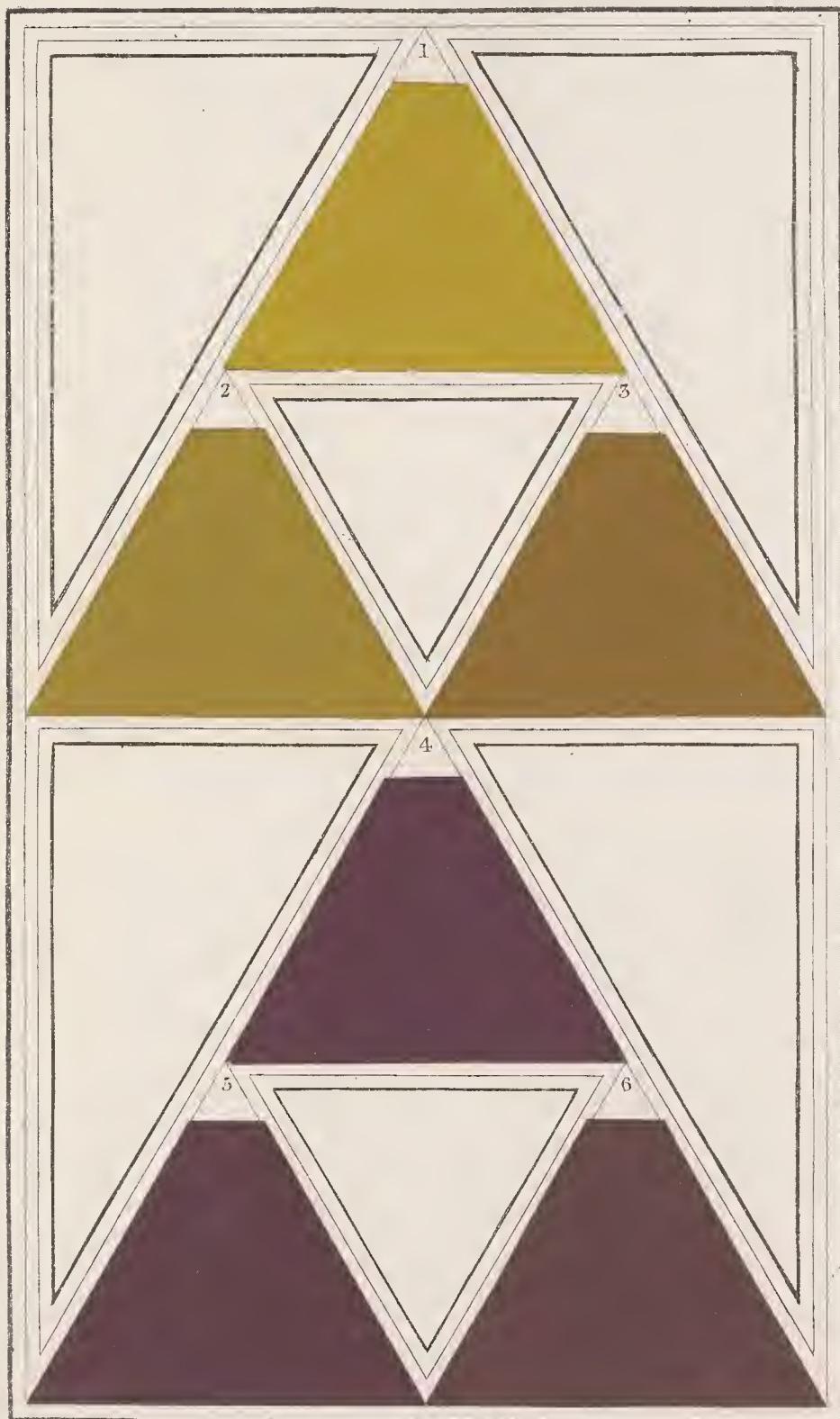
*Lizars sc.*







PLATE 24.



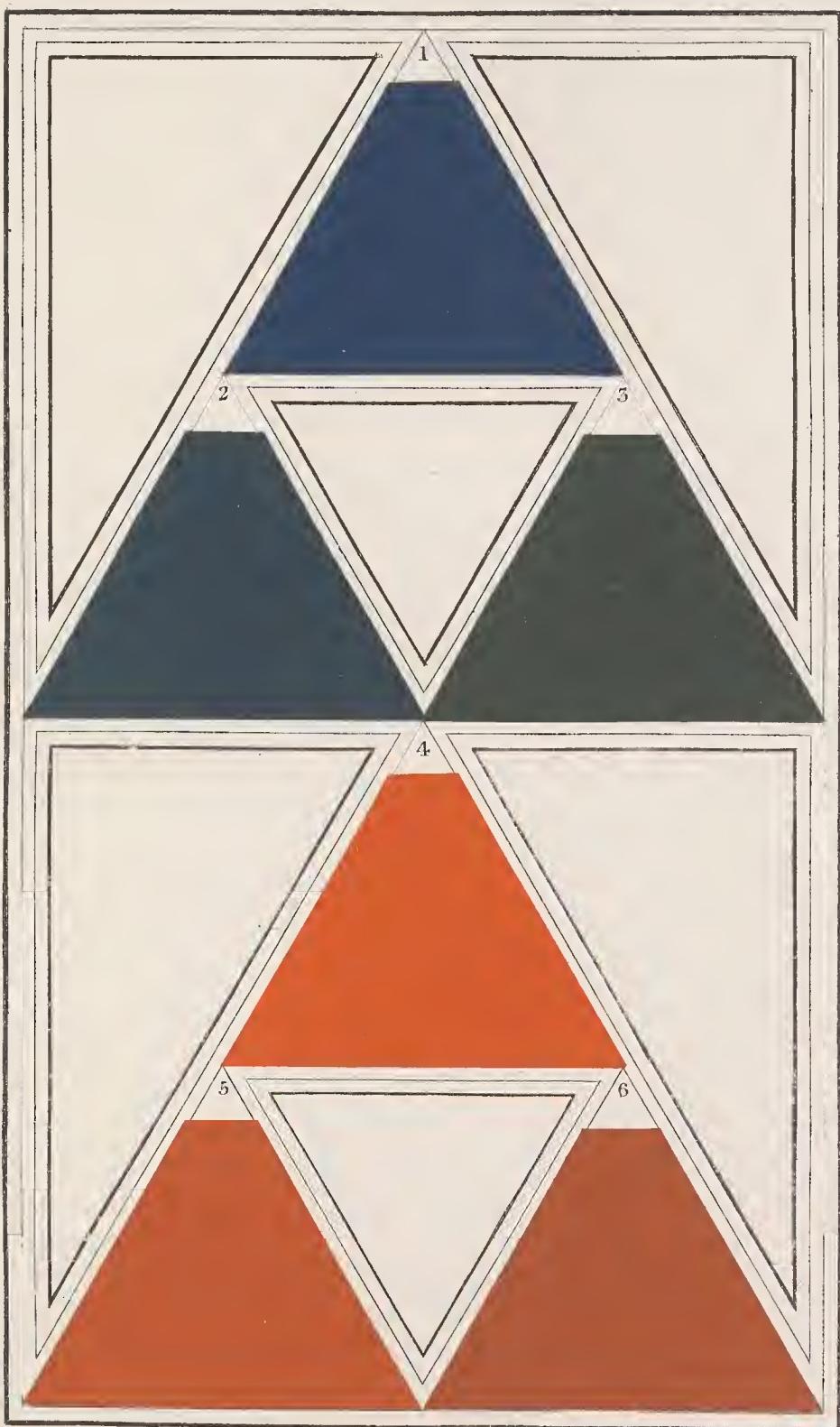
Lizars sc.







PLATE 25.



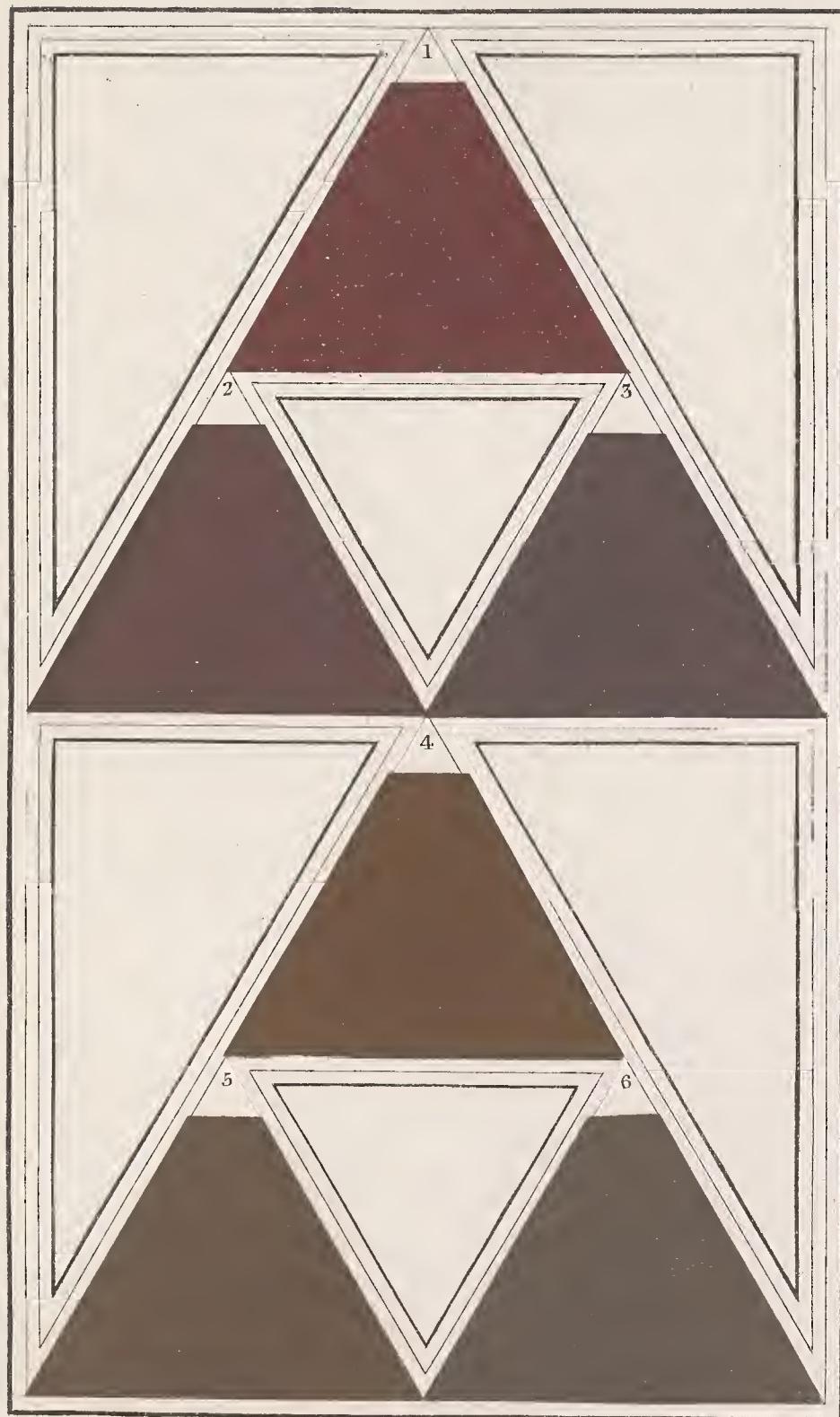
*Lizars sc.*







PLATE 26.



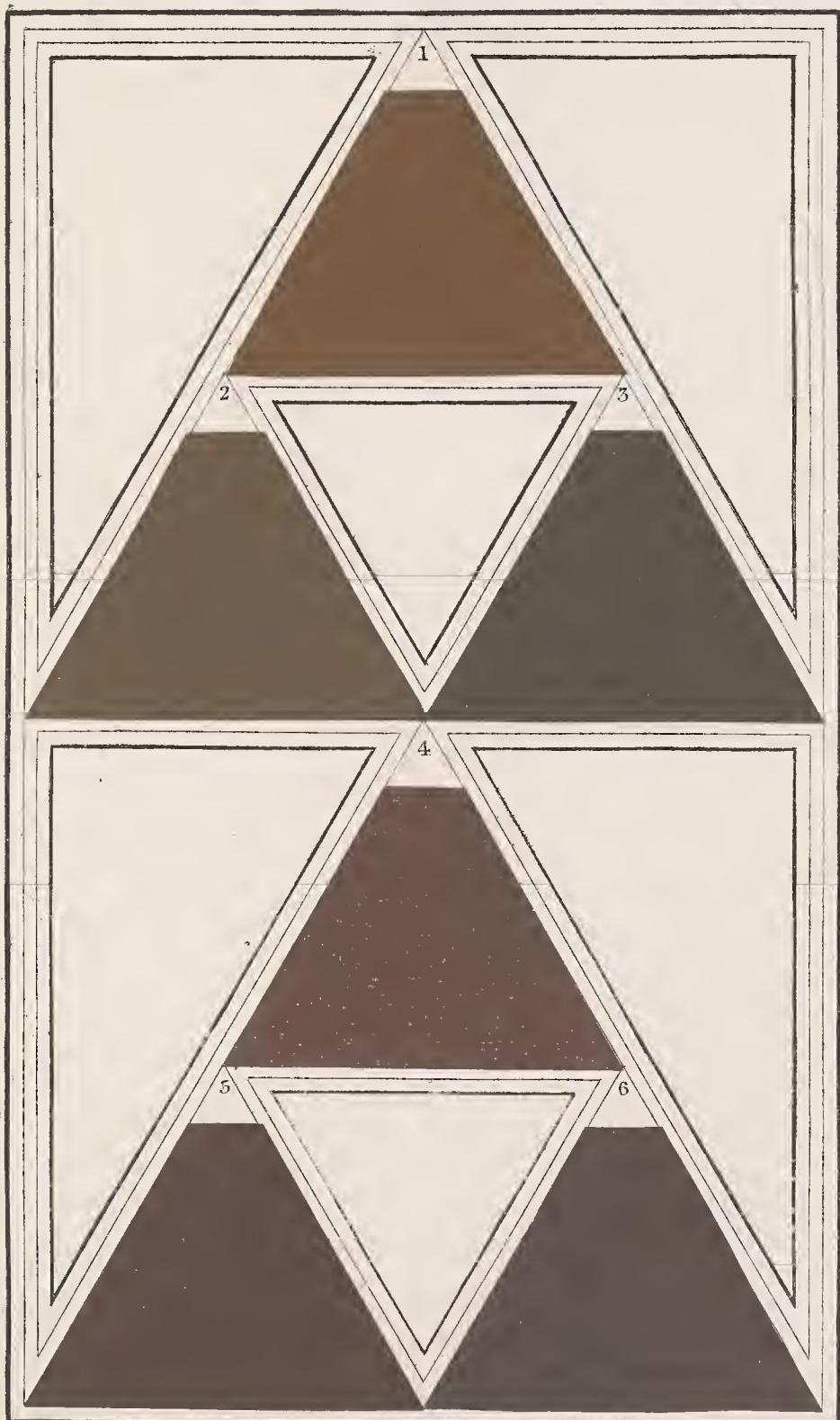
*Lizars sc.*







PLATE 27.



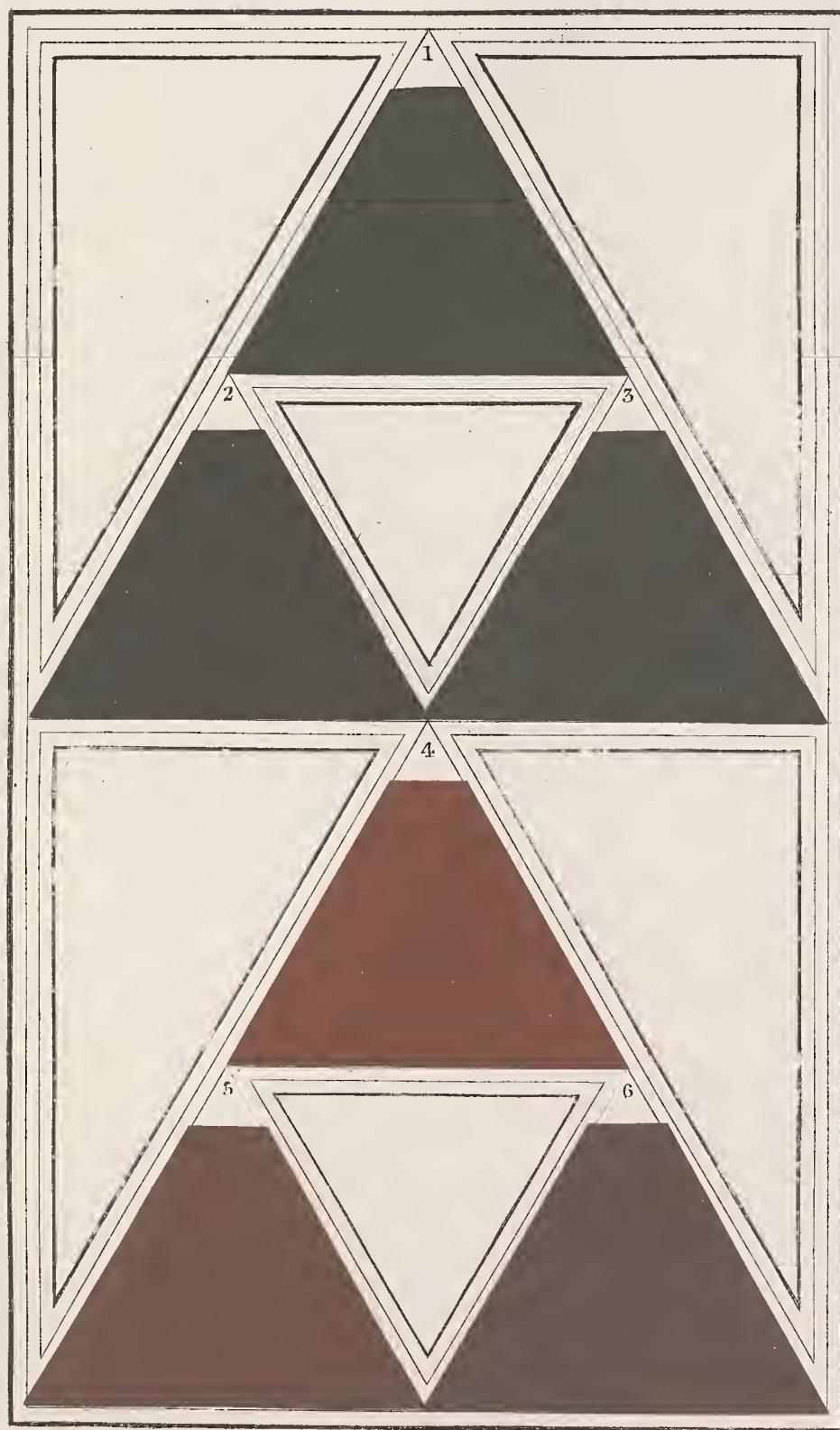
*Lizars sc.*







PLATE 28.



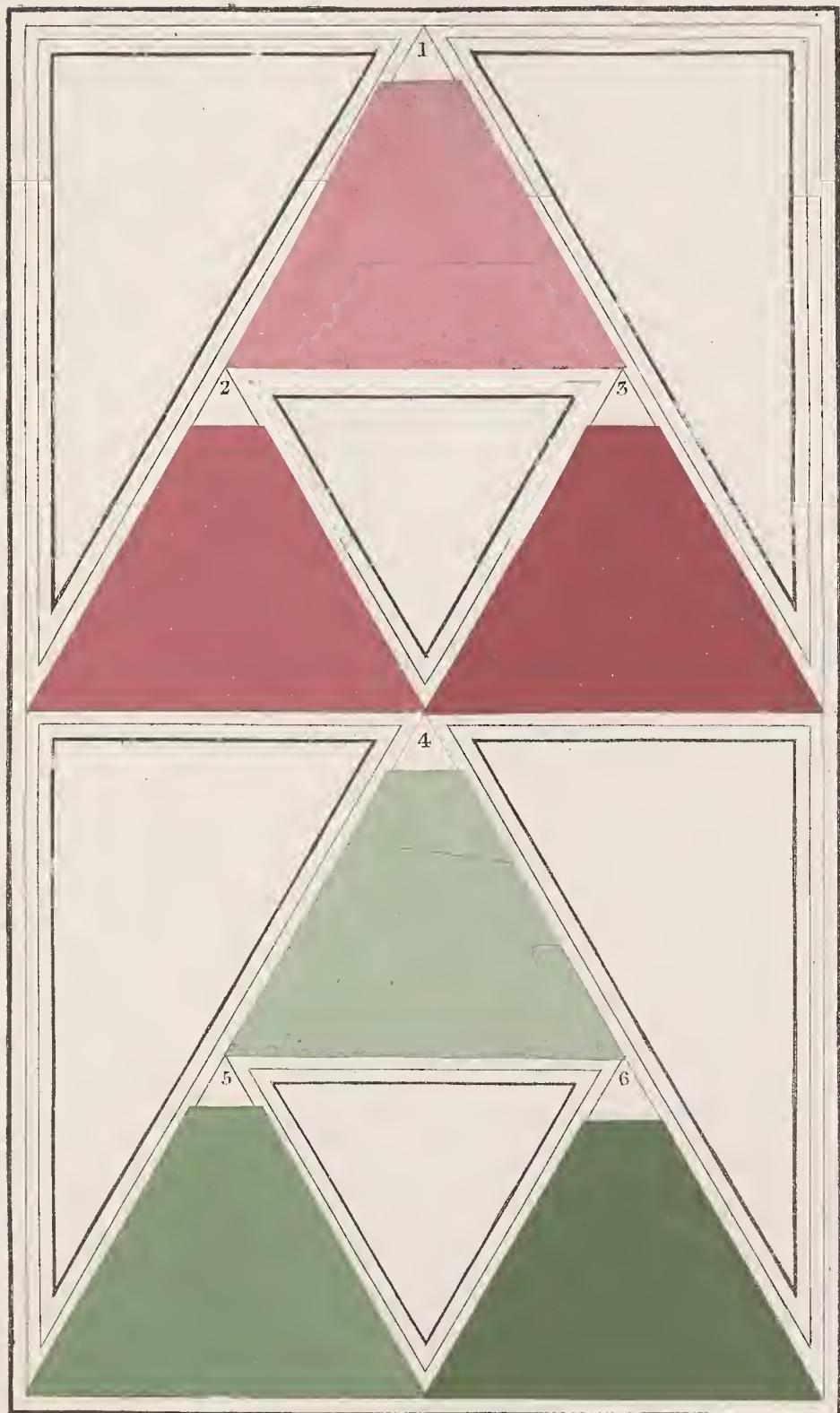
*Lizars sc.*







PLATE 29.



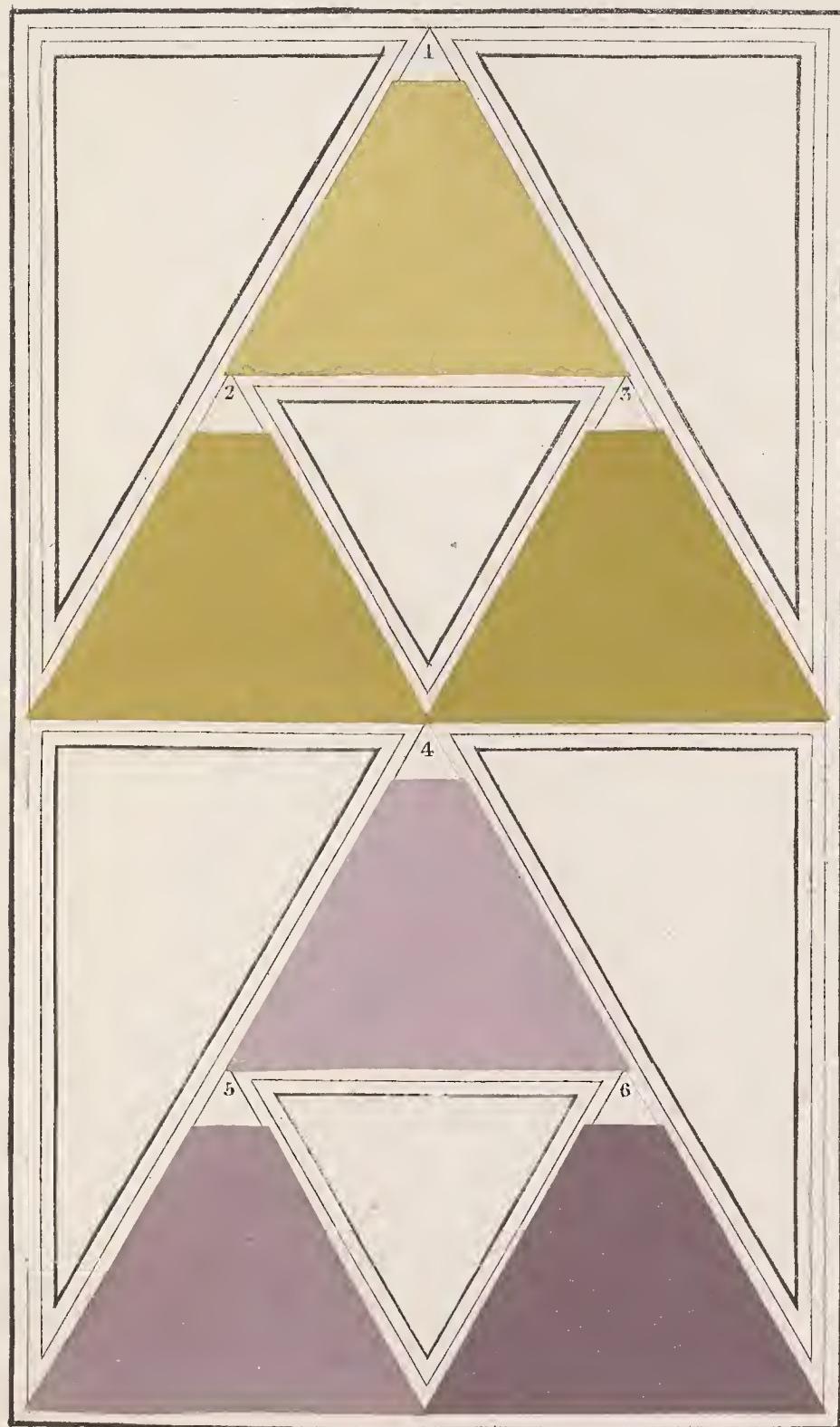
*Lizars sc.*







PLATE 30.



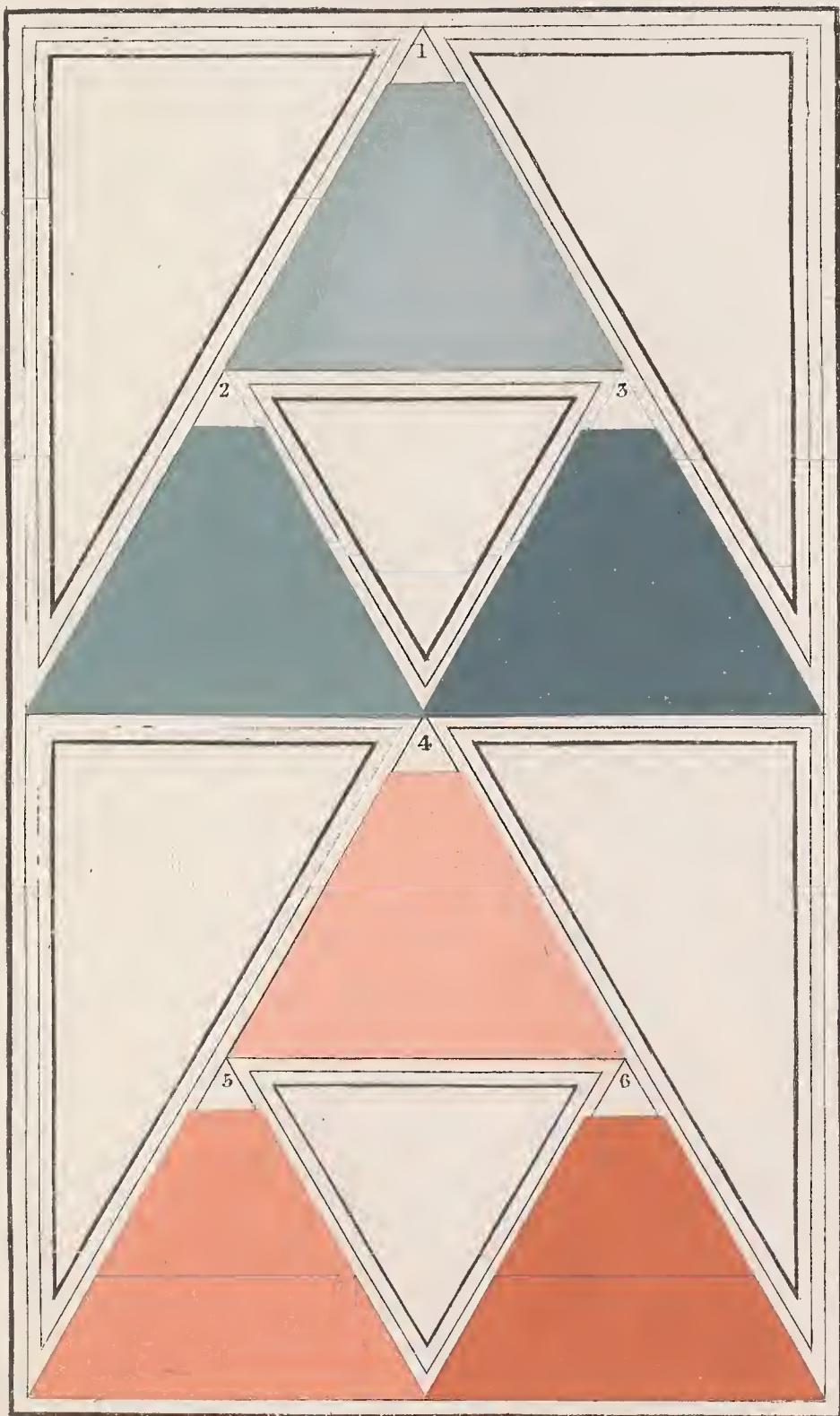
*Lizars sc.*







PLATE 31.



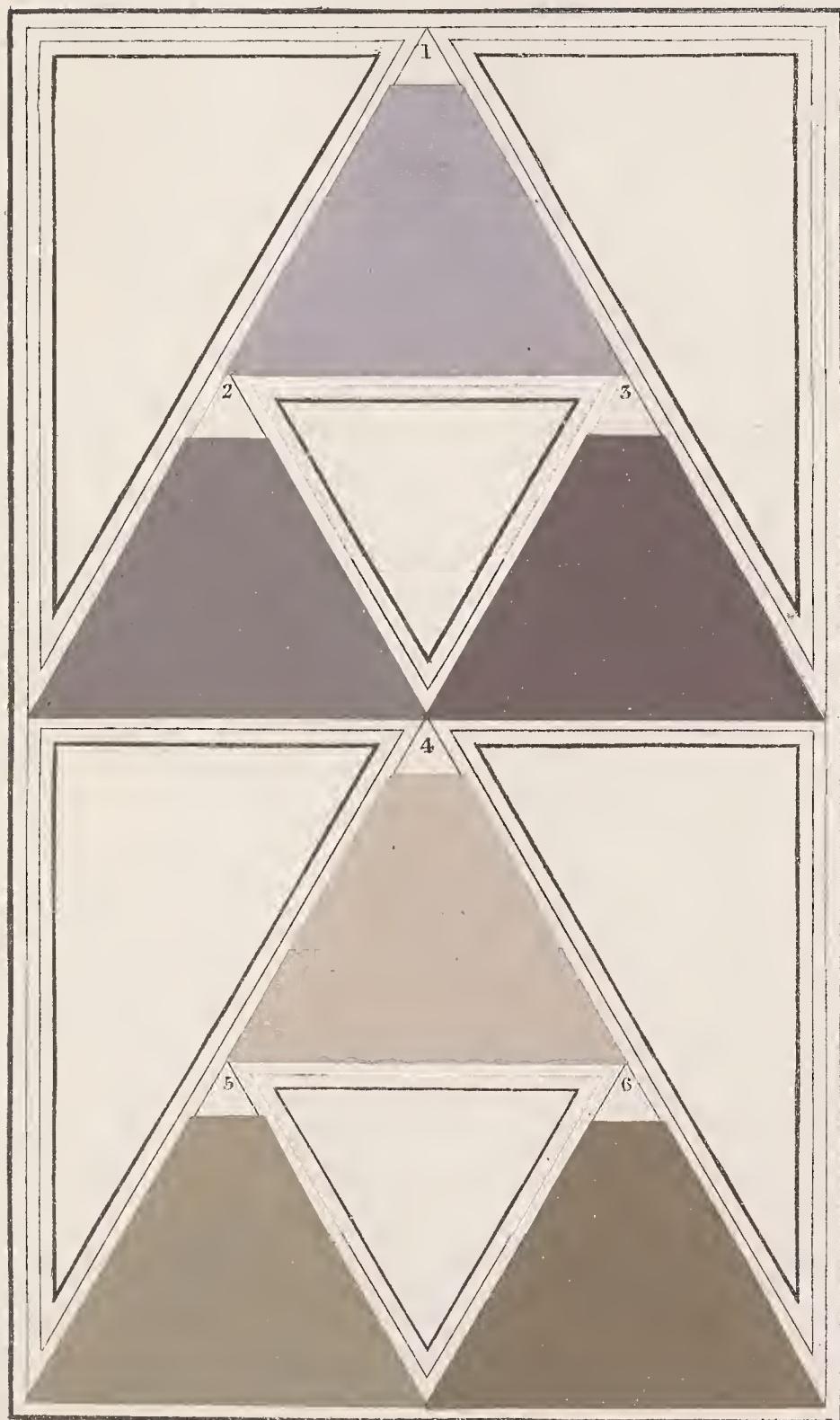
*Lizars sc.*







PLATE 32.



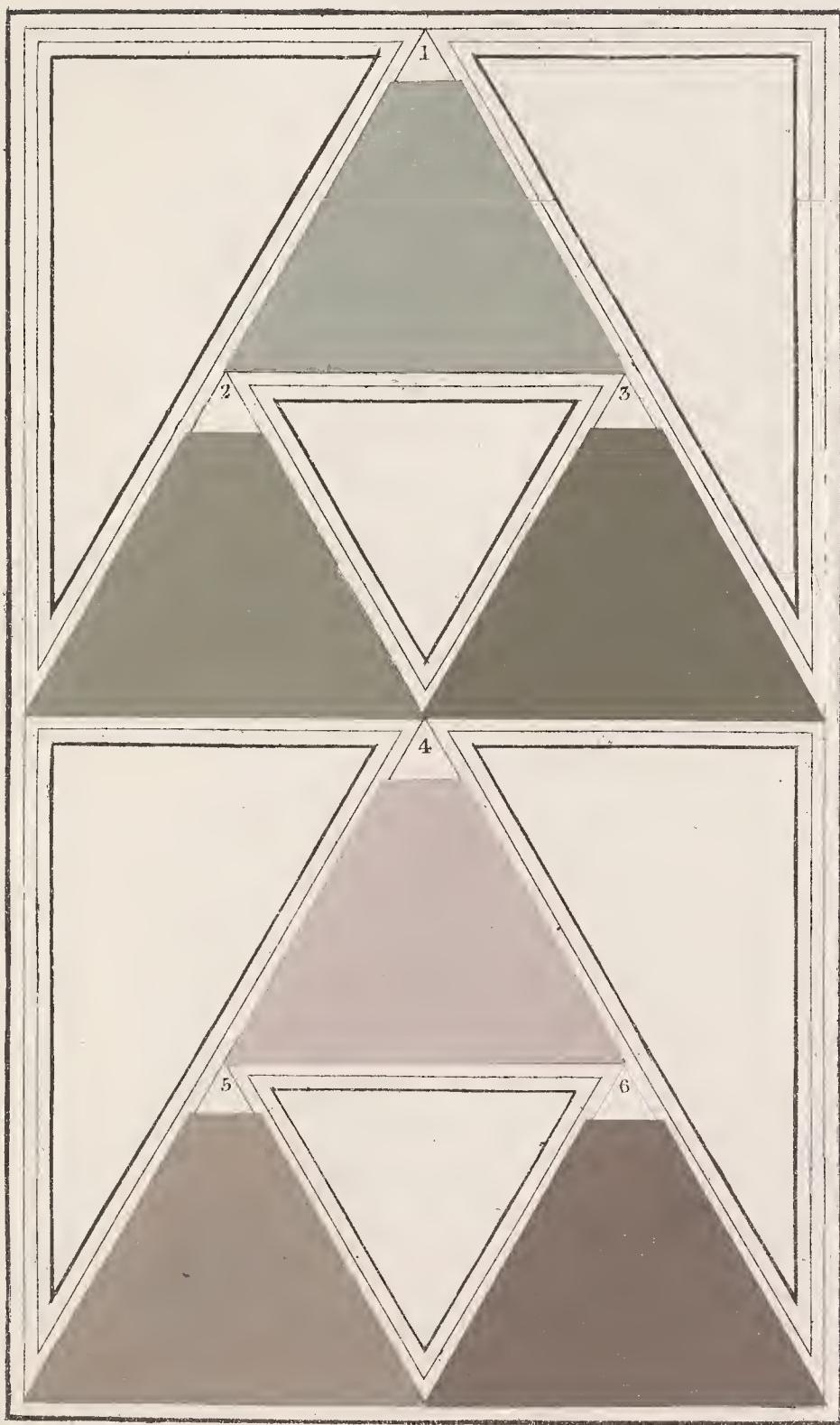
Lizars sc.







PLATE 33.



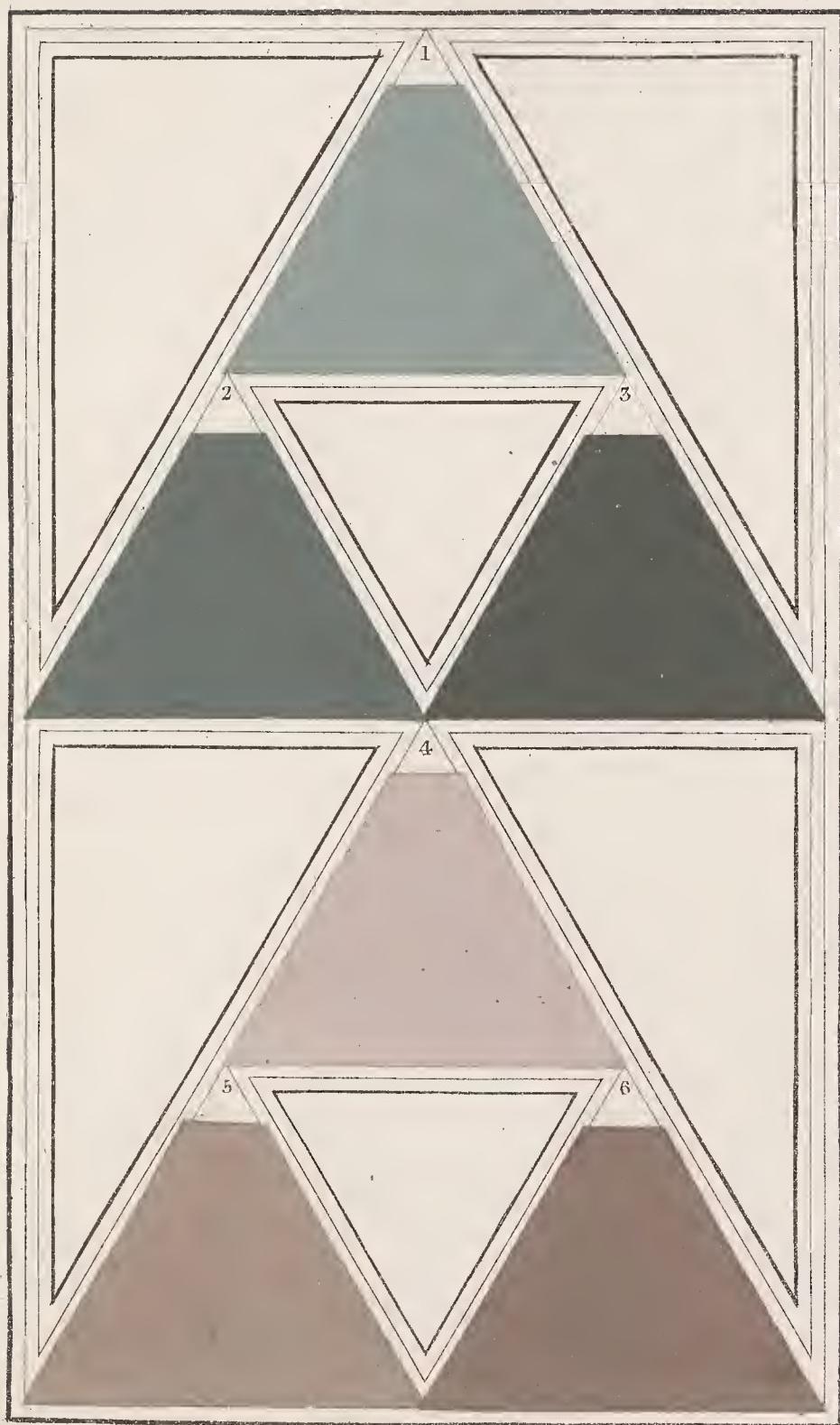
Lizaro sc.







PLATE 34.



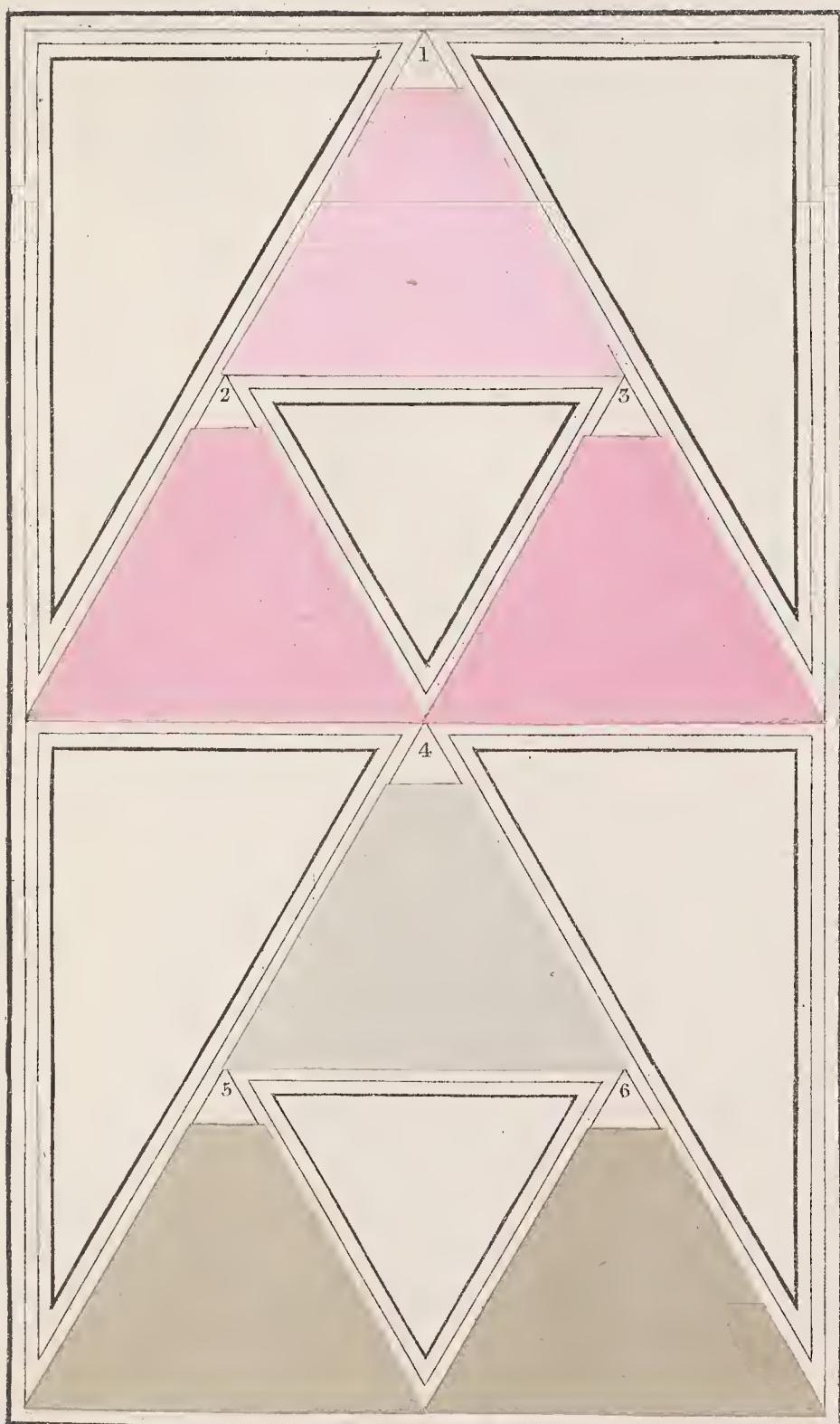
Lizars sc.







PLATE 35.



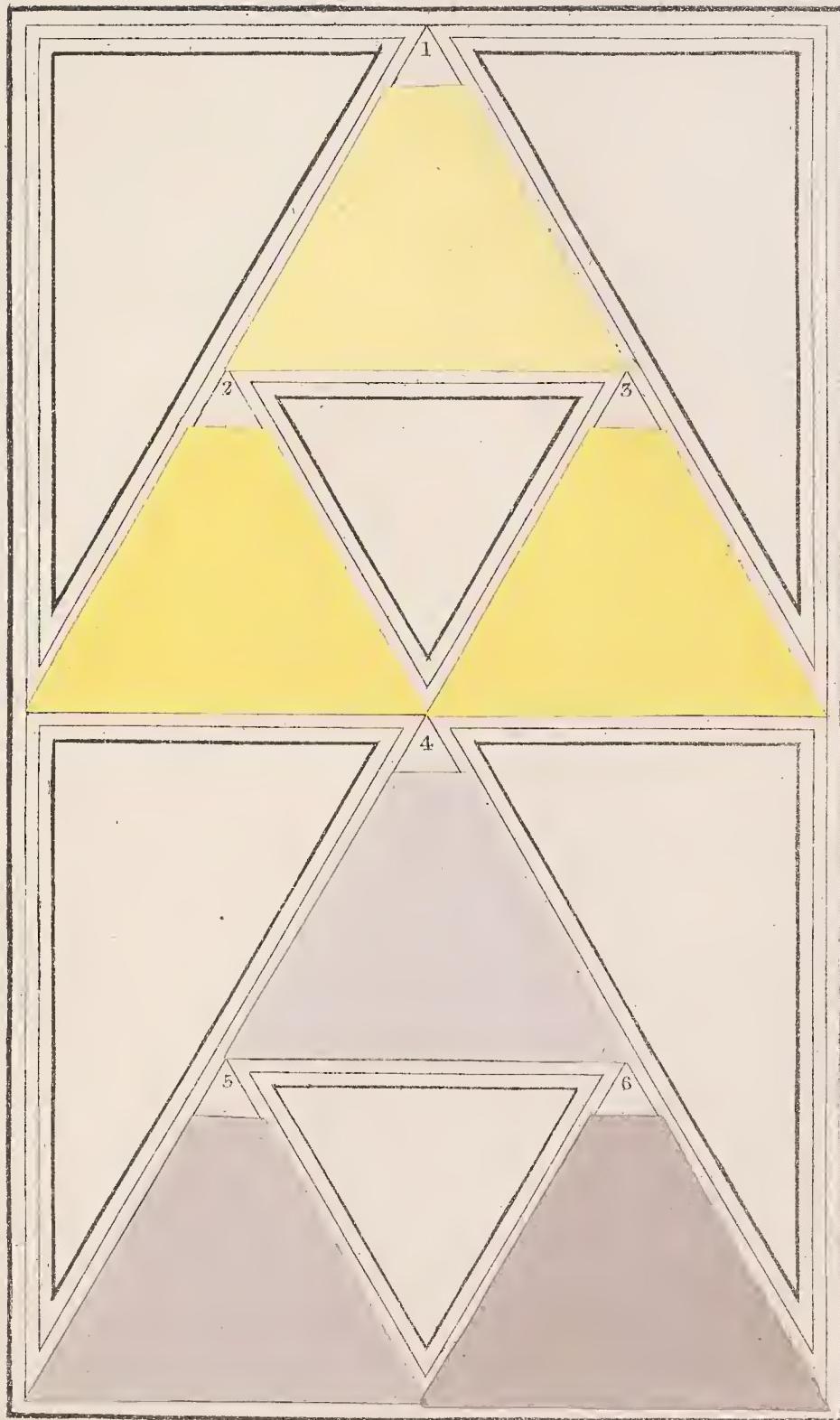
*Lizars sc.*







PLATE 36.



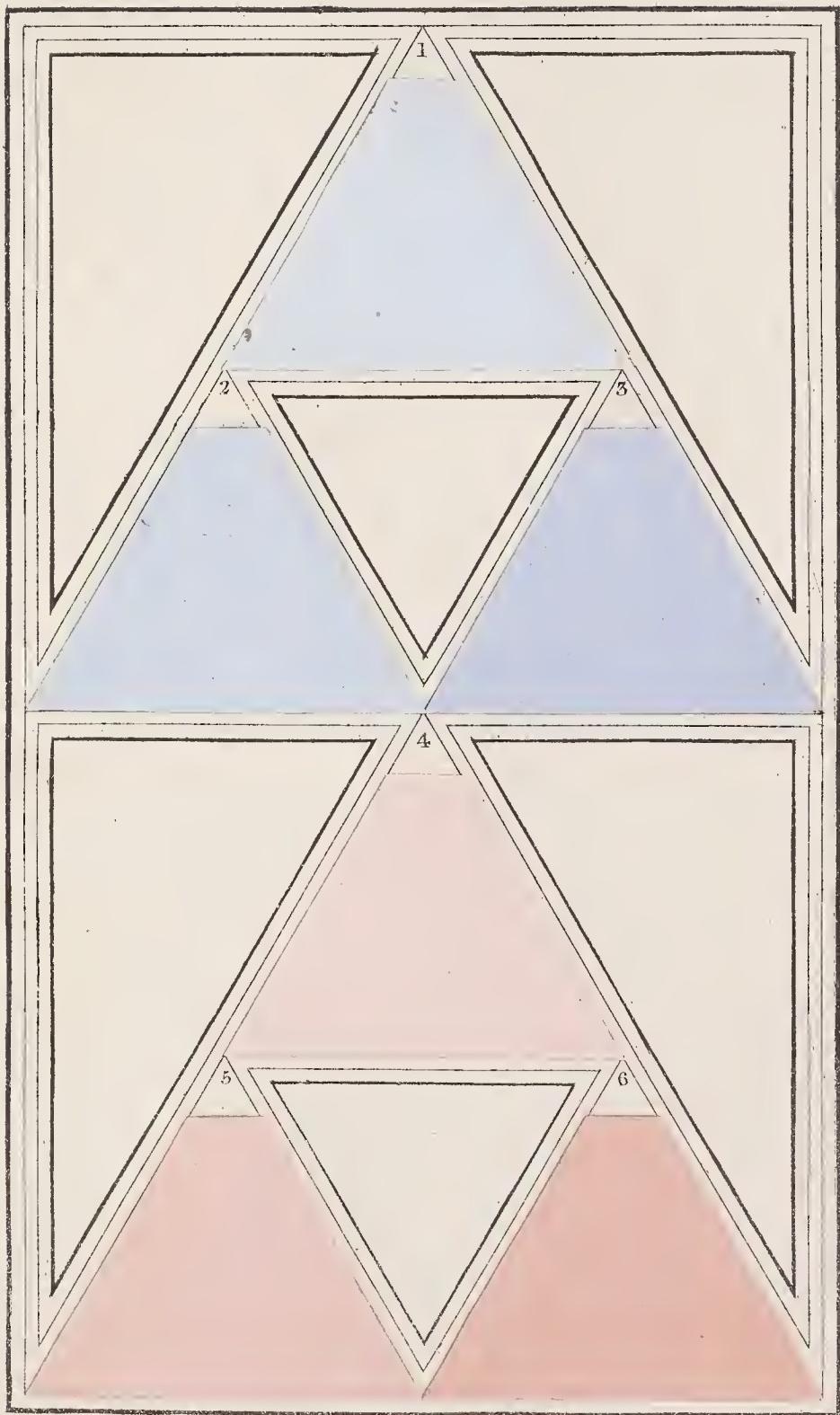
*Lizars sc.*







PLATE 37.



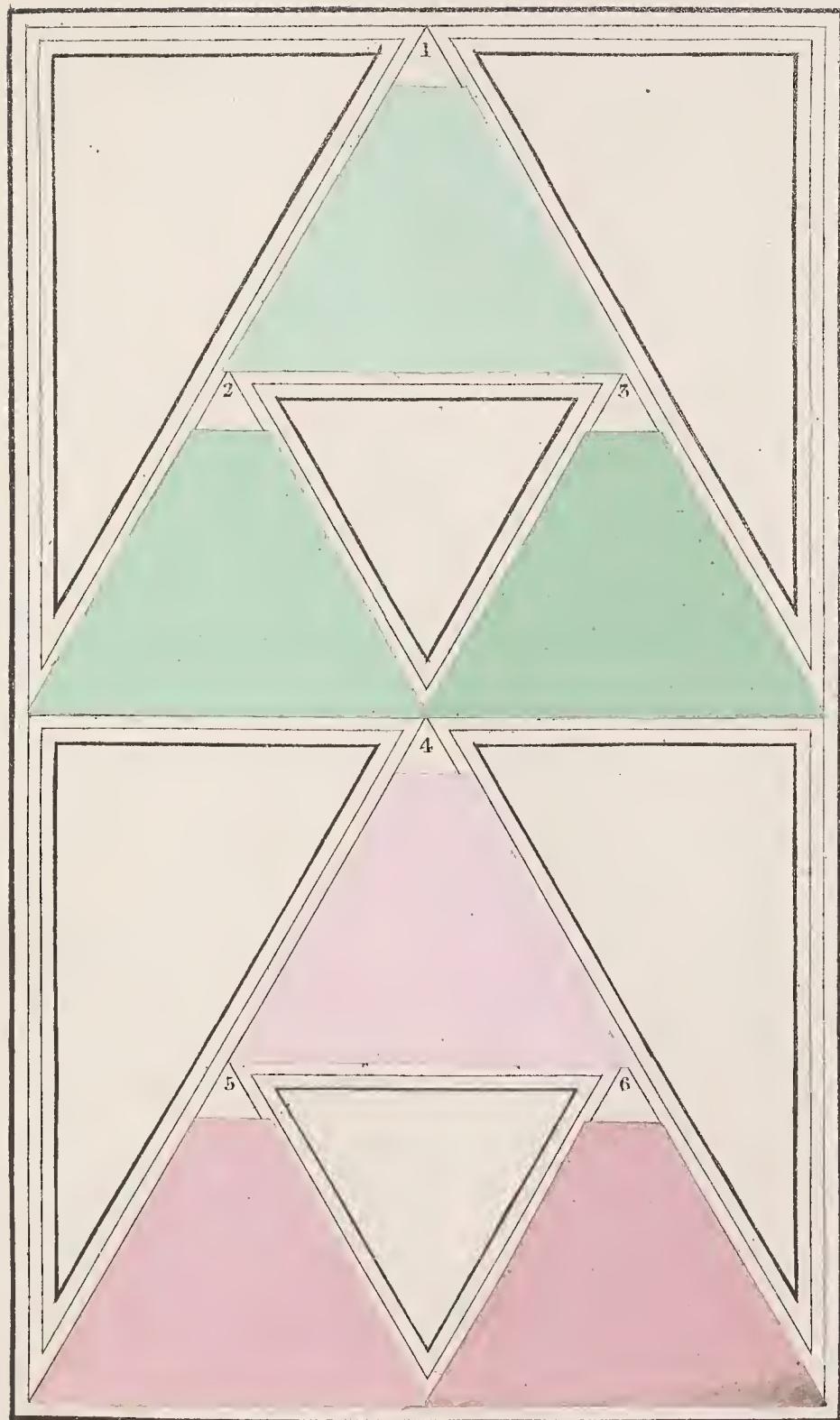
Lizars sc.







PLATE 38.



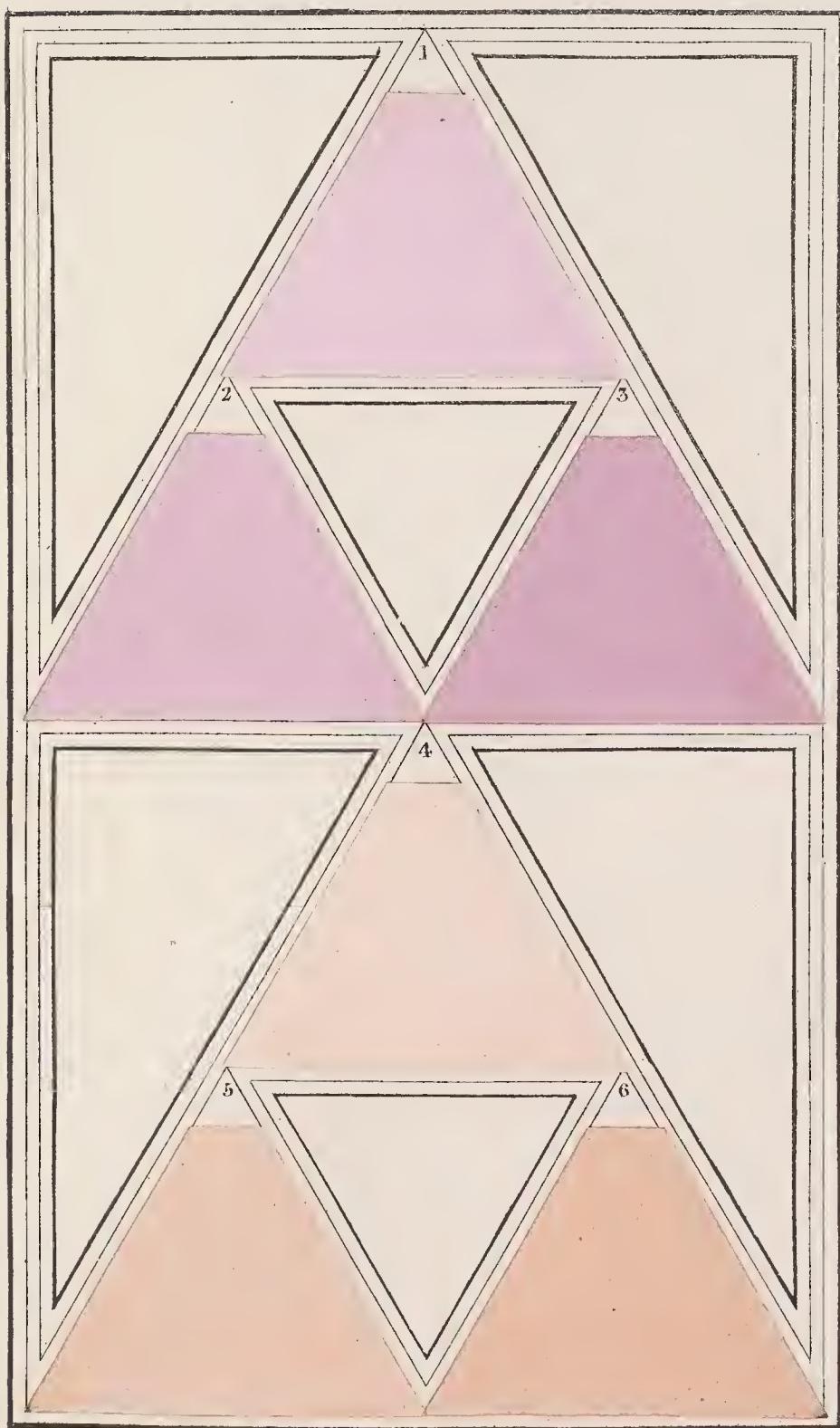
*Lizars sc.*







PLATE 39.



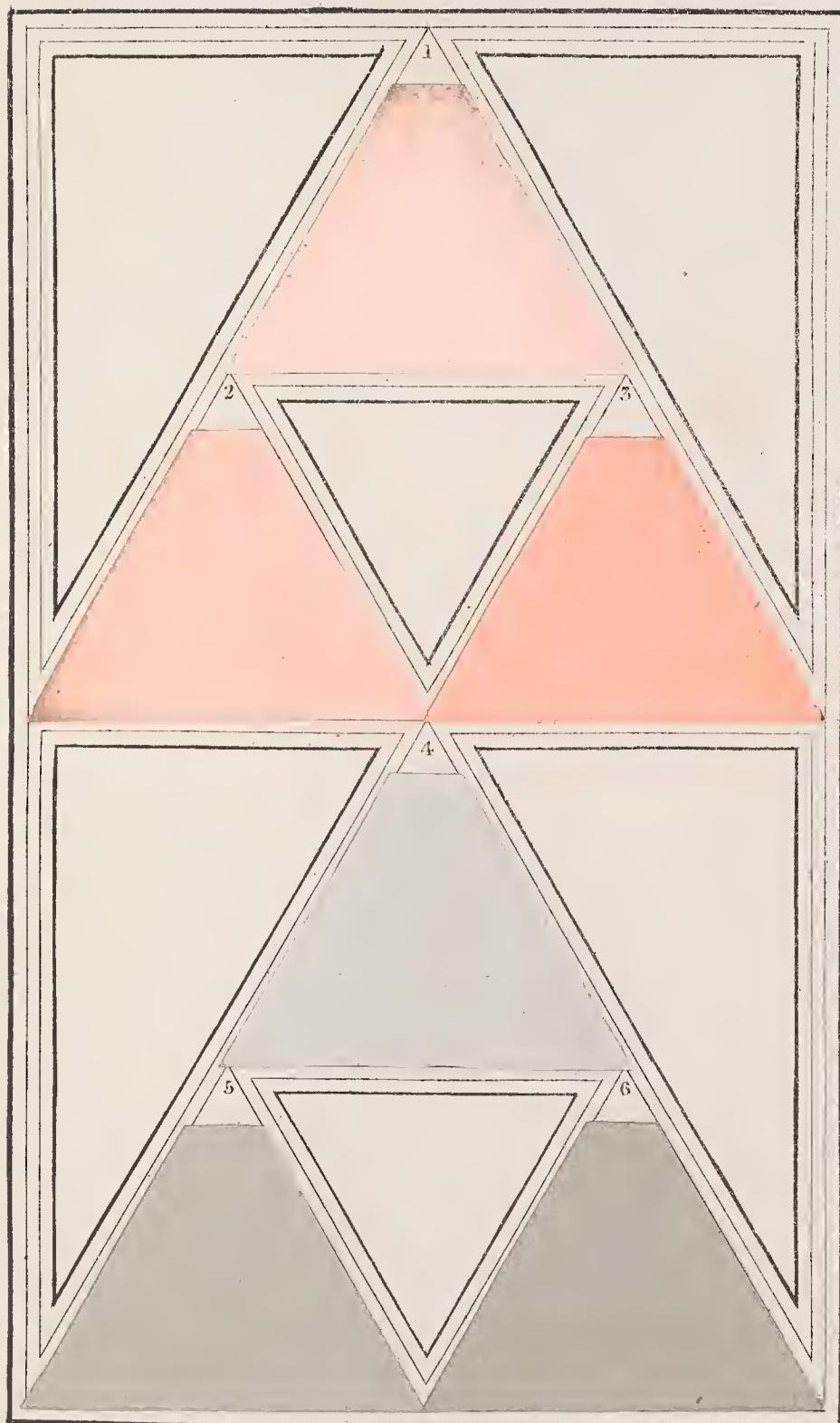
*Lizars sc.*







PLATE 40.



*Lizars sc.*







